THE

VETERINARY JOURNAL

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JULY, 1933.

THE BENEFITS OF EXPERIMENTAL RESEARCH IN ANIMAL DISEASES.

THIS issue of the Journal is especially illustrative of the necessity for experimental research in animal diseases and the benefits resulting therefrom; and the articles by Major Stirling on rinderpest immunisation of cattle; Messrs Alexander and Neitz on the transmission of louping-ill to sheep by ticks, and Dr. Green on the value of vitamins as a necessary constituent of dog foods, cover a very wide variety of the patients for whose welfare the veterinary profession is responsible. In no other way than by close observation methods such as come under the category of experimental research could any of these contributors have attained the results they specify; and these results not only mean an economic saving of hundreds of thousands of pounds to the owners of the animals, but health instead of painful illnesses to hundreds of thousands of animals themselves. It is only by observational work of this kind that the results of deeply thought out theories can be tested out and proved (or disproved), and it is good to know that in the near future veterinary research in Great Britain is to receive such encouragement as will enable its workers to compete on a more even footing with the opportunities allowed to our Continental colleagues.

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General Articles

SOME EXPERIMENTS IN RINDERPEST VACCINATION: ACTIVE IMMUNISATION OF INDIAN PLAINS CATTLE BY INOCULATION WITH GOAT-ADAPTED VIRUS ALONE IN FIELD CONDITIONS. (SECOND REPORT).

By MAJOR R. F. STIRLING, F.R.C.V.S., I.V.S.
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(1) Introduction.

THE first report upon the work indicated in the title of this article was published in this Journal in May, 1932 (Vol 88, pp. 192–204). Until the time of writing (January, 1933) prior to my departure on leave to Europe, the work had progressed for a further period of eight months, and this opportunity is taken of describing some of the most striking practical points that were revealed to us. During this interval a total number of 1,393 head of cattle had been inoculated by the method which we have already described.

The gross total of cattle, including buffaloes, vaccinated to June, 1933, has been 7,435 (*see* Addendum). The conditions in which the work was undertaken and the races of cattle subjected to the mode of immunisation, more especially in regard to the relatively high degree of natural resistance frequently seen in them to rinderpest, deserve some preliminary remarks, inasmuch as our experiences otherwise might seem rather strange to veterinary workers outside India, particularly those accustomed only to the cattle pathology of western countries.

It was not possible, owing to shortage of staff, to test the immunity of all the above cattle which had been vaccinated by inoculation with goat-adapted virus. About 10 to 12 only out of every 100 vaccinated cattle were selected at intervals of eighteen days to one year after vaccination for inoculation with highly virulent cattle virus, in the form of hill bull virus obtained from Muktesar, or virus obtained from a local natural outbreak. All the tested cattle withstood the test inoculation without fatality. A note in regard to the estimated cost of these vaccinations is given later.

Geographical Features of the Central Provinces.—The portion of British India known as the Central Provinces represents an administrative area, a Governor's province, almost equal in extent to the whole of France. It is situated mainly south of the tropic of Capricorn. The conditions in which cattle live in a tract of country of this size must obviously vary greatly. The whole area can be divided roughly according to its different geographical and economic features, into three tracts: (1) The Rice Tract.—The cattle in this tract are of small

size and relatively low value. It was here that the first large batches of cattle were inoculated by the method discussed in this paper. (2) The Wheat Belt.—On the plateaux in this area what is known in India as the " hill " type of cattle is found. (3) " Plains of India."—This tract is perhaps best designated by this name, and in it the farmer devotes his attention chiefly to the growing of cotton and the millets.

In these three tracts the indigenous cattle are maintained in somewhat widely different ways, and show, as the result of long exposure during their evolution to the different conditions of maintenance, rather striking variations in their physique and natural resistance to disease.

In the Rice Tract, the cattle obtain grazing only upon the banks (*bunds*) around the rice fields, and are diminutive in size ; they have been so frequently afflicted with the prevalent contagious diseases of the country that the present-day race of survivors shows a relatively high degree of immunity to all these diseases. In the Wheat Belt, on the other hand, the cattle present a much more sturdy appearance, and in a manner similar to what is so well known to exist among Himalayan hill cattle, they also react much more severely to infection, particularly with rinderpest. In the third area—the " Plains of India "—the local cattle, which are of high intrinsic value to the cultivators, are almost all stall-fed, and the greater attention paid to their maintenance seems to be associated with a corresponding diminution in their natural resistance to disease.

(2) Experiences in Goat-Virus Immunisation of Cattle against Rinderpest during the Period (eight months) since the First Report.

(*a*) *Effect of Economic Depression.*—One factor which limited the progress that could be made with the method was the prevailing general depression in trade conditions. This was aggravated locally by the irregular rainfall during the monsoon periods of the two preceding seasons, resulting in serious shortage of crops. The cultivators were, therefore, averse to placing in our hands large numbers of their cattle for testing what seemed to them a novel method of preventive treatment. In years of plenty they would be less prone to withhold their animals from apprehended risks of accident.

(*b*) *Active Immunisation at the Scene of Outbreaks and in their Immediate Vicinity.*—In the next place, during this interval rinderpest, which in India, as is now well known, undergoes an epizootic periodicity with a cycle of approximately three and a-half years, commenced to appear in an aggravated form, with frequent severe local outbreaks. The available staff of the veterinary department was, therefore, heavily engaged in applying passive protection as hitherto customarily applied, by serum inoculation to cattle at the scene of outbreaks, and it was only possible to obtain the kind permission of the Local Government to place one veterinary officer on special duty, whole-time, to prosecute the newly-introduced method of active immunisation.

It has never been claimed by us that this method is a highly suitable one for application in the scene of actual outbreaks, particularly in centres where

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infection is spreading rapidly. We are well aware in this department that after applying a method of active immunisation, a certain time (a few days) must elapse before the inoculated animal develops such a degree of immunity that will enable it to withstand exposure to natural infection. It is important that further observations should be made to determine the length of the period that must elapse after inoculation before immunity becomes effective. It is not likely that it exceeds the time taken for an animal to react distinctly to the goat virus inoculation, *i.e.*, no longer than about a week. Thus, when goat virus alone is inoculated we may reckon that the animal is not likely to stand up against a natural outbreak unless it has been inoculated for a period not less than a week before it was exposed. This point, which will undoubtedly seem rather obvious to the reader, is mentioned because the method we have been investigating has been criticised on the score that it is defective, inasmuch as it does not confer protection upon cattle in the scene of an outbreak. What we have always strongly recommended is that as many cattle as possible should be protected by the method during those times when the danger of attack from natural rinderpest is not imminent.

We have, indeed, long recognised that if we had in India a civil veterinary organisation equipped in the manner of such State organisations in the countries of Western Europe, backed with the requisite machinery of administration and police, so empowered that all animals susceptible to rinderpest could be brought under the operation of " standstill " measures for a period of about a fortnight, the disease would disappear, in the same way as it is now confidently regarded that it could be extirpated at any time after it had made its appearance in the European countries mentioned. To keep cattle at a standstill for even a day would be entirely impracticable in a huge extent of territory like India. This was forcibly borne upon us when in 1929–30 we endeavoured to limit the spread of foot-and-mouth disease (admittedly a much more difficult disease to control in its spread than rinderpest). Our attempts were defeated by the introduction of the " Sarda " Marriage Act. This Act prohibited the marriage of persons under a certain age, and in order to anticipate it, interested parties of inhabitants travelled far and wide in bullock carts to wed their sons and daughters. Foot-and-mouth disease then spread rapidly, and the veterinary department in the province was sorely exercised to apply any effective check upon the spread of the disease.

We know now that in rinderpest relatively close contact of susceptible animals with infected ones is necessary to ensure the spread of the disease. Bearing upon this problem, the following field experiment carried out by Mr. Pani, of this Department, assisted by Mr. Misra, is, we believe, of considerable practical significance.

The Kalkuhi Experiment.—Mr. Pani had been offered thirty-four head of cattle for vaccination by the goat-virus method in a village called Kalkuhi (*see* map). As soon as he had finished the inoculations a natural outbreak of rinderpest was reported in a village called Bichuva, about a mile away. The Kalkuhi

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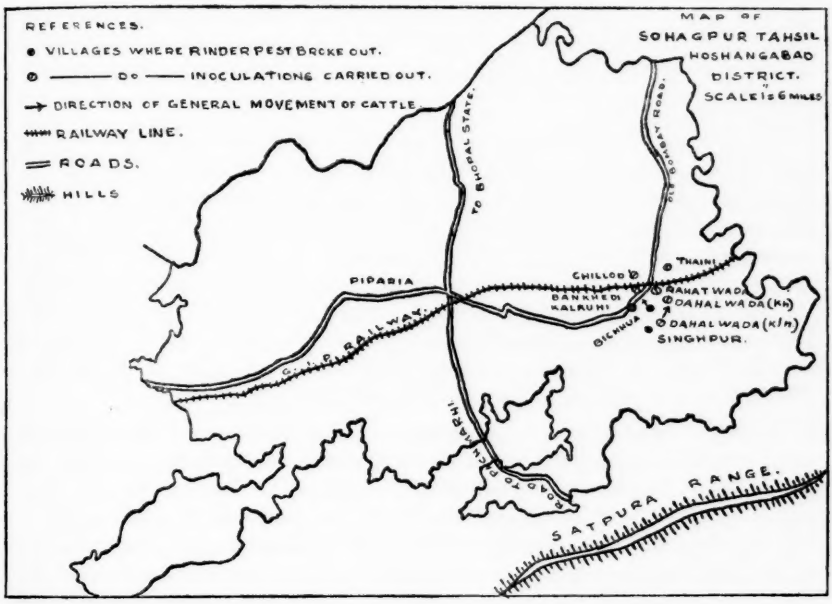
inhabitants were then implored not to mix their cattle with those at Bichuva for at least eighteen days, whereafter, to use Mr. Pani's words, they could " take them to Bichuva or any place in the world they like where there is rinderpest." Soon the disease spread from Bichuva to a closely situated village, Singhpur, where it assumed a very severe character, causing a mortality of nearly 50 per cent. among the cattle attacked. It was known from experience that virulent disease of this type would soon find its way to all the surrounding villages, with possibly increasing virulence.



Nothing appeals more to the mind of the Indian cultivator than to convince him of the value of any new method of protecting his cattle against a disease when that disease is already imminent. Mr. Pani, therefore, approached the farmers in five of the surrounding villages (Thaini, Chillod, Rahatwada, Dahalwada *kh* and Dahalwada *kln*—*see* map), and beseeched them to allow him to undertake protective inoculation, by the new method, of their cattle, on the condition that they would take strict care not to permit their cattle to graze or mix in any way with those of Bichuva or Singhpur. Meanwhile, Mr. Misra carried out preventive inoculation by the serum-alone method in the two affected villages.

Mr. Pani prudently commenced operations in a village three miles away from the affected villages because there was always some danger of stray cattle bringing

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across infection, even though he had extracted promises from the villagers that they would not allow their own cattle to escape. He then worked gradually nearer the affected centres, until at last he reached Dahalwada *kh*, which was only half a mile away. This work took him about twenty days, and during this time, as has already been said, Mr. Misra was doing his best to smother the disease in Bichuva and Singhpur by the serum-alone method.

In all, 400 animals were inoculated in the five villages by Mr. Pani. Incidentally, it may be said that the total cost of active immunisation was Rs. 25 (=37*s.* 6*d.*), whereas the cost of inoculating the same number of animals by the serum-alone method, which would confer protection for a period not exceeding nine days, would have been over Rs. 100 (£7 10*s.*). The result observed until the time of writing (*i.e.*, after five months) has been that there has been no further spread of rinderpest in this area.

This field experiment clearly shows that the spread of rinderpest from a severely affected centre of the disease can be promptly arrested without difficulty by the application of methods that are not costly, provided always that the support of the owners themselves is forthcoming and it is possible to spare the services of a trained operator for the work for about a month. In default of these conditions being available, the procedure cannot be advocated, and as a routine system in the face of extensive outbreaks in the field it would be beset with many difficulties. However, it is a system which might be of great value in protecting small areas in which herds of especially valuable cattle were kept, such as Government dairy herds, or a number of herds under the control of one owner.

The experiment is also of particular interest inasmuch as it bears directly upon a hope expressed by Edwards (1928)* when he originally described the possibilities of the goat-virus method of vaccination : " Short of this, nevertheless, it ought not to be considered merely as a sanguine hope to look forward to the day when a large proportion of the cattle of India, and particularly of the more valuable cattle, will be protected against rinderpest artificially, and in proportion as the duration of the artificial protection is solid and lasting there would be interspersed among the susceptible stock belts of animals or scattered individuals that would effectively cut up the chain of transmission of the disease, and thus bring about at any rate a commensurate diminution in the virulence of the infection for the cattle population generally."

It may be remarked here that in another outbreak one of the veterinary workers of the department, Veterinary Inspector P. S. Pillai, employed goat virus inoculated simultaneously with the low-potency serum (Class P) issued ordinarily from the Muktesar Institute for the serum-alone method of inoculation. The results obtained were excellent, showing at any rate that the degree of serum protection (and hence the cost entailed) required when goat virus is employed

* Edwards, J. T. : " The Problem of Rinderpest in India." Imp. Inst. Agri. Res. Pusa, India, Bull. No. 199 (Govt. of India Central Public. Branch, Calcutta, 1930).

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instead of cattle virus in the serum-simultaneous inoculation, can be very much lowered.

(c) *The Use of Goat Virus after a Short Series of Passages in Goats of Cattle Virus Harvested from Natural Outbreaks.*—It had been mentioned in our First Report that we were obliged, on account of difficulties experienced then in obtaining regular supplies of the fixed goat virus from the Muktesar Institute, to resort to attempts at adapting virus ourselves by direct inoculation of goats from natural outbreaks in cattle. It was found that the infection could be transmitted in this way to goats without much difficulty. It was also found in the preliminary attempts recorded that the use of virus obtained after a few passages in goats was not attended by any excessive risk. It was realised that goat virus obtained in this way might not have become attenuated for the bovine species so as to have attained the degree of safety described in Edwards' experiments at Muktesar, when he had subjected the virus to prolonged passage in goats. However, the exigencies of field procedure in India demand economy and simplification in all methods of this kind, and it was of interest to determine whether or not goat virus, of the required degree of activity, could be made available by ready-to-hand methods in the field. It now seems to be quite clear from our further experience that although the field-adapted virus was often satisfactory it could not be relied upon to set up in cattle uniformly a mild infection, without any danger to the inoculated animals. In some cases, our results would seem to show that the virus underwent considerable attenuation in the goat after one passage, and then showed some exaltation in virulence on further passage. In other cases the virus became gradually attenuated in virulence on passage in goats. The importance of obtaining goat virus of constant low virulence for cattle is, naturally, greatest in the case of the progeny of indigenous cattle that have been crossed with highly susceptible imported stock. Unfortunately, we were not able to test our methods upon the progeny of first crosses, as all such animals had been immunised by the serum-simultaneous method in 1930. The following short summary of our results is given from the records maintained by Rai Saheb R. V. Pillai :—

The area selected for the experiments comprised a hilly district in the Wheat Belt (already referred to above), within which the local cattle were known to be far more susceptible to rinderpest than those of the area (the Rice Tract) dealt with in our First Report.

Batch No. 1 (Padar, Betul).—Ten head of cattle received a dose of rinderpest virus (alone) which was derived from a local natural outbreak in cattle, and had been passed through the goat once. The goat had shown a decided reaction on the fourth day after injection. The inoculated cattle reacted satisfactorily, and subsequently withstood a test inoculation with cattle virus.

Batch No. 2 (Padar, Betul).—Emboldened by the above experience, the officer in charge of the inoculations proceeded further to inject 42 more head of cattle in the same village. The virus used was the same, but had been passaged once

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more in goats (*i.e.*, second passage goat virus). Thirty cattle reacted mildly, while the remaining 12 showed typical clinical symptoms of rinderpest. Of these 12 severe reactors, 11 finally recovered, after suitable nursing treatment only, while one (a buffalo) succumbed. The officer in charge reported that this buffalo was sent to graze by its owner against his instructions in a *jungle*, and although it did not return for two days, no inquiries were made as to why it had not returned ; death was probably caused by exposure during the extreme heat in May and want of nursing.

Batch No. 3 (Nimpani, Betul).—Sixty-two head of cattle each received a dose of goat virus, third passage, from a local natural outbreak. Only three animals showed a severe type of reaction, while the remaining 59 passed through the infection without noticeable symptoms. No deaths occurred in this batch.

Batch No. 4 (Mahatgaon, Betul).—One hundred and five head of cattle each received a dose of goat virus, fourth passage, from a local natural outbreak. Twenty-four reacted severely, while the others showed only a mild reaction. Of the severe reactors, three calves and one bullock succumbed ; the others, including the mild reactors, recovered.

Remarks.—It is clear from the above that the use of goat virus, after a few passages only in goats, is not a justifiably safe method of preventive inoculation. The officer in charge of the inoculations had been over-enthusiastic in undertaking vaccination in this way because of the delay he had experienced in getting goat virus from Muktesar. The plan was approved of by us afterwards inasmuch as the inquiries we were pursuing would receive adequate answer, we believed, from the tests. Although the death-rate was insignificant (5 in 219), we do not wish to receive setbacks of this kind at this stage of the work. It was, therefore, decided to fall back upon the use of fixed goat virus obtained from Muktesar in further tests.

In two of the above batches, comprising together 147 animals, the depression in body resistance of the inoculated animals caused coccidiosis to " light up " clinically in 13 cases, and piroplasmosis (*B. bigemina*) in nine cases. All these cases recovered, after suitable treatment, namely, copper sulphate drenches in coccidiosis and trypanblue injections in piroplasmosis. A temperature and clinical history chart of an animal that showed recrudescence of piroplasmosis is reproduced on page 297.

Batches 5, 6 *and* 7.—In all, thirty head of cattle were inoculated with Muktesar goat virus, locally tested for virulence. All passed through a mild reaction and recovered.

Test of Muktesar Virus upon a Cross-bred Calf.—The above Muktesar virus was next inoculated into a cross-bred (quarter Ayrshire, three-quarter Montgomery) calf—August 20th, 1932. On the seventh day the temperature rose to 105° F. ; the animal showed only mild symptoms of febrile disturbance, which would otherwise not have been definitely diagnosed as rinder-

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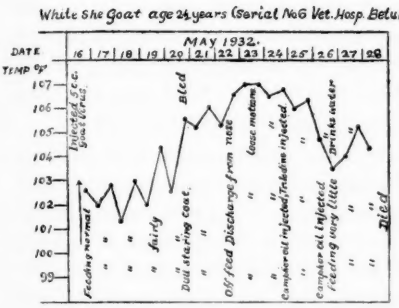
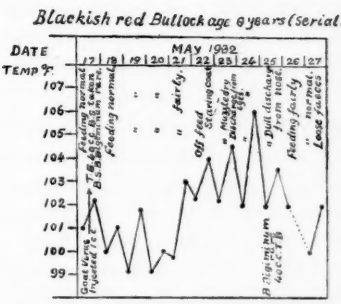
pest. A month after the original injection the calf was inoculated with 5 c.c. of Muktesar hill bull virus controlled locally as to its virulence.

(*d*) *The Efficacy of the Method.*—A convincing proof of the protective value of the method was obtained in the course of these operations (on the Wheat Belt plateaux). Two neighbours living side by side in one part of a village that was visited had each twelve cattle. One man was persuaded to have his animals vaccinated ; the other refused. About two months later rinderpest broke out in a mild form in the village, and a message was sent for serum. Before the veterinary officer could arrive to perform the inoculations with serum alone, five of the animals belonging to the man who had refused to have his cattle inoculated were attacked with rinderpest, and despite the use of serum in large doses, two



A chart demonstrating a severe reaction in a goat virus producer. It shows a combination of the pneumonic and diarrhœal stages, which is perhaps unusual but not rare.



A chart showing a typical case of the recrudescence of piroplasmosis, even although the animal had received 40 c.c. of a 2 per cent. trypanblue (T.B.) solution at the time of giving the goat virus injection.

of them died, causing him a loss of Rs. 150. At the same time, and throughout the outbreak, his neighbour's cattle enjoyed the best of health.

(*e*) *Duration of Immunity in Vaccinated Cattle.*—The following test shows that the immunity resulting from inoculation by this method lasts at least a year. Three batches of cattle were selected from among those which had been inoculated about a year previously by the goat-virus method. They were taken from three villages (namely, 15, 10 and five head of cattle respectively taken at random from these villages) within the Raipur area, *i.e.*, within the Rice Tract, in which our operations were commenced as described in our first report (November to December, 1931). All were inoculated with rinderpest virus obtained from a natural outbreak in cattle in the same locality. None showed any reaction.

In the first report it was stated that Batch No. 1, which was inoculated in November, 1931, with goat virus, comprised 11 animals. Of these, seven were tested with Muktesar hill-bull virus and four were kept in reserve, and of the latter only two were forthcoming two months later for test of their immunity.

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In November, 1932, Mr. Pani returned to the same village and tested the immunity of five of the above animals ; one of these had been tested with local virus in January of the same year, and three had been tested with Muktesar virus, while one had had no test inoculation. Each was given 5 c.c. of virulent blood obtained from a local outbreak in cattle, in which there were thirty-five cattle attacked, with twenty deaths, a fairly normal record of mortality for this part of India. None of these inoculated animals showed any sign of rinderpest.

Mr. Pani then proceeded to another village in which goat virus inoculations had been done twelve months previously, *i.e.*, in December, 1931. He was anticipated by the occurrence of a natural outbreak of rinderpest in the village. None of the inoculated cattle became affected. However, to obtain further proof of the efficacy of the method, he took virulent blood from an animal showing acute symptoms of rinderpest, and injected it immediately into fifteen cattle which he had vaccinated in the preceding year. None of these animals showed any trace of reaction. The landlord of the village expressed publicly his gratitude to the veterinary department. In all, thirty cattle were tested one year after the goat-virus inoculation by injection of local virus, and all survived the test.

Test after Eighteen Months.—In the first report it was stated that the first animals inoculated by the method, by Mr. M. James, belonged to a village in which an organised rural uplift movement was in progress. Of the four animals inoculated, two, namely a buffalo aged twelve years and a bullock aged ten years, were still in the village eighteen months later. They had been vaccinated with the goat virus on July 8th, 1931, and eighteen days later they received a test inoculation with Muktesar hill-bull virus. During the Christmas holidays of 1932, the writer visited this locality, and was fortunate in finding a natural outbreak of rinderpest in a village twenty miles away from where the above two animals were kept. On December 26th, 1932, *i.e.*, over eighteen months from the time of vaccination, virulent blood from an acute case of rinderpest was hurriedly despatched in a thermos flask from the scene of the outbreak by a motor cyclist, and immediately injected into the buffalo and bullock, and also into an uninoculated buffalo calf, which was to serve as a control. On January 2nd and 3rd, 1933, both the vaccinated animals were in perfect health, whilst the calf showed all the symptoms of acute rinderpest, and despite persistent attempts at treatment, it died on the eighth day after inoculation. At this time both the buffalo and bullock were seen working in the yoke. This is the longest interval during which it has been possible so far to demonstrate the duration of immunity after goat-virus inoculation.

(*f*) *Attempted Conservation of Goat Virus* in vitro *for Use in the Field.*—Having regard to the risks that may attend the use of goat virus for cattle inoculation when it has been derived after a short series of passages from a local field strain, the difficulty in obtaining goats, on hire or by purchase, in some villages, and the delay experienced (a minimum of five days journey by post) in getting supplies of the fixed goat-virus from the Muktesar Institute, attempts were then

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made to conserve at our local headquarters supplies of goat virus that had been found to behave satisfactorily in cattle inoculations.

It is now well known that active virus is present in infected blood only within the white blood corpuscles, which constitute a very minute proportion of the total volume of the blood. This was taught long ago at Muktesar by Dr. Lingard to his classes of students there, and in recent years the phenomenon was investigated there further by Dr. Edwards. Normal fresh blood serum was found by him to be highly toxic towards the virus, whereas after heating (50° C. for an hour) the serum lost its toxic properties and became, in dilution (5 to 20 per cent.) in normal saline or Ringer's solution, a good preservative medium for the virus, particularly when the virus was suspended in this fluid enclosed in the white corpuscles separated by repeated washing from virulent blood. The rate of destruction increased with rise of temperature, as with other viruses and bacteria, and, conversely, was delayed with fall of temperature. The method recommended for trial to conserve a good strain of good virus was, therefore, the following :

(1) Inject about half a dozen strong, healthy goats with the fixed goat virus. (2) Bleed out sterilely when they have shown a distinct thermal reaction, about the fifth day, into strong (about 4 per cent.) citrate saline, so as to prevent clotting of the blood, to make a concentration of about 0.3 per cent. sodium citrate in the blood. (3) Centrifuge the blood, or, failing a centrifuge, allow the blood to sediment in a sterile tall cylinder or flask placed in a Frigidaire or cool chamber. (4) Pipette or syphon off the clear supernatant serum, then withdraw carefully by means of a sterile pipette the whole of the thin white creamy layer overlying the mass of deposited red cells. (5) Suspend this layer of white corpuscles, now mixed with a large proportion of red cells, in citrate saline (0.3 per cent. sodium citrate + 0.85 per cent. sodium chloride) in a narrow sterile glass vessel. Centrifuge or allow to settle again in a cool chamber. (6) Repeat this process two or three more times, suspending the creamy layer, freed as much as possible each time from red cells, in saline-citrate. (7) Suspend the small volume of white corpuscles finally obtained in dilute (10 per cent.) heated (50° C., for half an hour) serum in saline in a convenient small bulk, and retain in the Frigidaire at 0–5° C., not freezing, until required. The whole of the leucocytes of 100 c.c. blood can readily be suspended in 5 c.c. or less bulk.

We have made some attempts to preserve stocks of virus by the above method ; these have not been, on the whole, successful, but unfortunately we have not had sufficient funds hitherto to purchase animals in the numbers required to give the method a fair trial. The results we have obtained, however, furnish ample evidence to show that the method ought to be well worth while in the hands of those who can afford the material and equipment necessary. A dose of under 0.1 c.c. of the leucocyte suspension is sufficient to produce a rinderpest reaction upon subcutaneous inoculation. Some records kept by Rai Saheb R. V. Pillai of experimental attempts to conserve the virus in the above way are the following :

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(A) A goat which showed a typical rinderpest reaction was bled and its blood treated by the above method, finally suspending the leucocytes in 10 per cent. heated goat serum. The suspension was kept in the Frigidaire at 7 to 10° C., and from the third to the fifth week it was tested for virulence by inoculation into goats and bulls. (i) Injected 2 c.c. of above suspension, which had been kept for one month, into a goat. The animal showed a rise of temperature (105° F. and 105.4° F.) on the seventh and eighth days after inoculation ; no other symptoms were noticed. This was a delayed reaction, for goats show a decided reaction after they have been inoculated in the ordinary way with fixed virus on the fourth and fifth days. (ii) Injected 2 c.c. of the above suspension into a cross-bred bull calf (quarter Ayrshire, half Montgomery, quarter Hissar) after storage for seven days in the Frigidaire. On the seventh and subsequent days after inoculation a rise of temperature about 103° F. was noticed ; on the thirteenth to fifteenth days, there was a rise to about 105° F. There was some doubt, therefore, as to whether this was really a rinderpest reaction. After six weeks the calf was given a dose of Muktesar hill bull virus ; it then showed a typical mild rinderpest reaction and recovered. (iii) Two c.c. of washed leucocytes obtained from the blood of a goat which itself had been inoculated with washed leucocytes was inoculated after ten days storage into a cross-bred calf. The temperature reaction recorded was somewhat irregular. The calf received a dose of Muktesar hill bull virus six weeks later. The animal showed a decided mild rinderpest reaction (thermal and clinical) and recovered.

(B) In field inoculations one group (= Lot A) received washed leucocytes as above, prepared from the blood of a goat which had been inoculated with a dose of goat virus (*i.e.*, direct strain). A second group (= Lot B) received washed leucocytes obtained from a goat which had been inoculated with a dose of the above washed leucocytes of the direct strain. No positive result was recorded.

(g) *Cost of Inoculations.*—During the period covered by this second report, a total number of 1,393 cattle were inoculated, as already stated, at an estimated total cost of Rs. 230 for all charges, excluding cost of staff. This works out at approximately threepence a head. The cost of vaccinating each animal would have been lower had it not been for certain difficulties, some of which have already been mentioned above in dealing with the attempts made at conservation of the virus. A reacting goat yields about 150 c.c. of virulent blood, the vaccinating dose of which is fixed arbitrarily at 1 c.c. (although probably a far smaller dose would suffice with the blood of most donors). Hence, enough virus could be harvested from one goat to vaccinate at least 150 cattle. Our experience hitherto, however, has been that it has been impossible to obtain anything like this number for inoculation in any one village. With only one trained operator available to carry out the necessary work, fresh supplies of virus had to be produced for inoculations at the next village, perhaps five miles distant. Thus there was considerable surplus and wastage of goat virus at each passage. This wastage

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would not have been so marked if more trained helpers had been available to use up the harvested goat virus.

The question of cost in its bearing upon the peculiar conditions regarding cattle ownership and maintenance in India has been discussed in our first report. Trivial though the sums involved in prophylaxis may seem to workers in other countries, such as, for example, those accustomed to the expenditure entailed in controlling foot-and-mouth disease in England, a disease which is of minor significance in India relative to rinderpest, yet they represent a factor which is all-important in attempting any sort of effective disease control among the huge cattle population of India. This is reflected in the tone of a message received from one of the senior veterinary officers in India: "Come up and see me over your work. We as a province can certainly not afford an expensive method of protecting our cattle, and something cheaper must be found." It is certain, at any rate, that high charges for the cost of material, comparable with those now made in England in the vaccination recommended against distemper in dogs, another so-called virus disease, would foredoom the method to immediate failure as a practical measure of field prophylaxis.

(*h*) *The Rinderpest Reaction in Goats inoculated in the Field as Virus Producers.*—After subcutaneous inoculation with the virus, the rinderpest reaction in goats was observed to pass through the following stages: (1) incubative; (2) febrile; (3) pneumonic; and (4) diarrhœal.

(1) *The Incubative Stage.*—The stage extends over a period of one to three days from the time of inoculation, and during this period the animals feed well. (2) *The Febrile Stage.*—This begins from the third to the fifth day, and is characterised by a rise in body temperature. The animals often display inappetence, and have a staring coat; they adopt a peculiar crouching position while they are standing, and show some degree of jugular pulsation. Pregnant goats usually abort. The febrile stage is followed by either the pneumonic stage or the diarrhœal stage, or by both these stages. (3) *The Pneumonic Stage.*—This stage is seen from the sixth day onwards after inoculation. The coat shows a marked staring appearance; there is a discharge from the nose, coughing, heavy and hurried breathing, general depression, complete inappetence, and a high temperature. The rate of mortality during this stage is high. (4) *The Diarrhœal Stage.*—This may begin on the sixth day, or even later, concurrently with the pneumonia. The animals become progressively duller, and show rapid emaciation and soft fæces. This stage ends sometimes in death. Animals often recover after a slight febrile attack, and may also recover after the onset of distinct pneumonia or diarrhœa. The death-rate among goats used as virus producers is about 15 per cent.

Points to be Observed in Harvesting Virulent Blood from Goats.—The most important point is the selection of the goat donors, for individual goats may vary considerably in their behaviour towards inoculation with the rinderpest virus. It is essential for this reason to inoculate not less than two goats each time a

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supply of virulent goat blood is required. The goats should be neither too old nor too young ; it is always preferable to have goats between two and three years of age. There is a decided advantage in selecting male goats, for the production of abortion in female goats during infection is a disturbing factor. Virulent blood is withdrawn for use from reacting goats during the febrile stage, *i.e.*, on the fourth or fifth day after inoculation, when the temperature is 2.5 or 3° F. above normal.

When the virus is passaged in goats it is often found that during the first few passages only one out of two goats in each passage reacts satisfactorily. In such cases the non-reactor is discarded as a virus-donor, and virus obtained for further passage only from the other goat, which shows a reaction. In this way it is generally found that the two goats inoculated at each passage will eventually show a good reaction, often followed by a relatively high rate of mortality. Sometimes, however, by proceeding in this way the goats inoculated fail suddenly to react, as if the virus on further passage petered out. It is not advisable to discontinue further attempts at passage when goats fail to display an evident febrile reaction in this way, for inoculation of blood into cattle from the goats after the prescribed interval will show that it still contains active virus circulating in it.

Although the temperature record of an inoculated goat is a good guide to its suitability as a virus donor, there are certain clinical symptoms that ought not to be overlooked in estimating the onset of a rinderpest reaction in goats. It has been already mentioned that when the virus is passaged in goats the inoculated animals develop symptoms of pneumonia. Just before the onset of clinical pneumonia, a prominent symptom and a sure guide as to the imminence of pneumonia is the appearance of a jugular pulse, which in the goat species can be readily observed in the neck region. After some practical experience in observing large numbers of goat donors, the impression is gained that the use of the thermometer is not essential for estimating a good rinderpest reaction in a goat. By merely observing the jugular furrows of the goat one can obtain evidence of a reaction. In cases of this kind, which may show no distinct rise in temperature but display a jugular pulse and general depression, there is enough evidence to indicate that the blood is virulent. Confirmation is obtained by inoculating some blood from these goats into calves and noting their reaction. It is, therefore, important to note that the reactions obtained in the goats may be erratic, and that there may be no cause for despair when these animals seem to fail to react, for if one perseveres with further passage the reactions will often revive. One should always, however, in the case of apparently delayed reactions in goats confirm the specificity of the reaction by inoculation of blood into a susceptible calf.

(*i*) *Inoculation of Rinderpest Virus into Sheep.*—Mr. Pani was the victim of a somewhat disconcerting episode during the summer of 1932, in an attempt to use sheep instead of goats for the passage of the rinderpest virus. He found that he could not get enough goats in the locality in which he was then working,

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and he was sorely perplexed to keep the virus alive. It was then brought to his notice by the local veterinary officer that the Deputy Commissioner of the area had some sheep grazing in his compound. Two sheep were removed under cover of night, and it was hoped to use them for the passage of the virus, and restore them to their rightful owner in about a week. This was fully expected to occur in the light of his experience with goats. The sheep were duly injected, and to Mr. Pani's surprise they developed symptoms of acute rinderpest on or about the fifth day, and no efforts were availing to ward off a fatal attack. These observations on the relative susceptibility of goats and sheep call to mind some of the earliest work done in the experimental investigation of rinderpest, namely, Koch's classical experiments upon the disease in South Africa.

Koch's experiments (1897)* at Kimberley are now of particular historical significance in so far as he seems to have clearly anticipated the possibilities offered by passage of the cattle virus in goats and sheep. During the short period of his researches in the field, however, he did not press forward transmission in these animals beyond the seventh passage. His results were, briefly, as follows :

(*a*) A heifer was inoculated with the blood of an Angora goat infected with rinderpest, second passage. The heifer developed well-marked rinderpest, but afterwards made a complete recovery. This result tended to show that the virus had become less active for cattle by passage through goats, and further passages were then undertaken.

(*b*) Four cattle were inoculated respectively with virulent blood obtained from a goat, an Angora goat, a Merino sheep, and a Cape sheep, containing virus at fifth passage through these animals. All four developed clinical rinderpest after a short incubation period, and three succumbed after seven to eight days. The course of the disease in the two cattle inoculated with the blood of Merino and Cape sheep was so very acute, and the post-mortem lesions so severe that the cattle virus was not only unattenuated, but rendered more active for cattle by passage through sheep. The hope that sheep could be used for the production of a vaccinating agent thus proved illusory. The ox inoculated with the blood of the Angora goat showed merely a febrile temperature for five days, a hardly noticeable diarrhœa, and soon recovered. The ox inoculated with the blood of the Cape goat, which was in poor condition, succumbed ; the post-mortem lesions were much less severe than in the cattle inoculated with sheep blood.

Koch, therefore, concluded that the rinderpest virus probably underwent a real but slow attenuation for cattle, on repeated passage through goats, and contemplated carrying out further experiments in this direction. As none of the above small ruminants succumbed, he examined after slaughter a Merino sheep which had shown a characteristic high temperature curve : although the stomach showed hardly any abnormality, there was distinct inflammation in the small

* Berichte des Herrn Prof. Dr. Koch über seine in Kimberley gemachten Versuche bezüglich Bekampfung der Rinderpest.—Centralbl. f. Bakt., I. Abt. 1897, vol. 21, 526–537.

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and large intestines, and especially in the rectum. The nasal mucous membranes showed changes identical with those seen at the same stage in slaughtered cattle. These experiments explained well enough, he thought, the great differences shown in the clinical picture of rinderpest in sheep and goats. Many farmers were of the opinion—and this was confirmed by his personal observations in the Orange Free State—that these animals could be put to graze with sick cattle without becoming attacked, while, on the other hand, rinderpest first appeared in numerous cases in herds of sheep and goats which had been kept separate from the larger ruminants. His view was that sheep and goats became at first affected with such mild rinderpest that it could not be diagnosed clinically, then symptoms became distinct, with fatal results in many cases, only when the virus had propagated actively in the bodies of these animals.

(3) Summary and Discussion.

The work described in this second report was undertaken on the plateaux of the Wheat Belt described above, of the Central Provinces, after nearly 600 cattle had been successfully immunised by the new method of vaccination with goat-adapted virus in the Rice Tract, as described in our first report. An attempt was first made in this belt to use as a vaccine, instead of rinderpest virus adapted to goats by long passage in these animals, cattle virus that had been obtained from local natural outbreaks and was then transmitted through goats for only a few passages. This expedient did not prove satisfactory; out of 219 cattle inoculated, five succumbed accidentally to infection; fairly severe reactions were seen in some of the other cattle. In two batches, comprising 147 animals, the infection " lighted up " coccidiosis in 13, and piroplasmosis (*B. bigemina*) in nine; these secondary infections were, however, successfully treated. The inoculation of forty-two more cattle in this Belt with goat-virus (Muktesar origin) adapted to goats by prolonged passage proved safe and successful. In all, 1,393 cattle were immunised by the method during the period (eight months) covered by the present report. The only fatalities were the five already mentioned. Distinct symptoms were seen in a number of the cattle undergoing immunisation, more particularly those containing some admixture with imported blood. Ordinarily, among the indigenous cattle, with the virus adapted by prolonged passage, these symptoms were inapparent or negligible. It was shown by field experiment that the resulting immunity extended over a period covering at least eighteen months.

The efficacy of the method of immunisation when applied to villages in close proximity to the scene of natural outbreaks is described, provided certain measures are taken to control the movement of cattle. The course of infection in the goat is described. Some preliminary attempts are also recorded in the conservation of stocks of goat virus in the laboratory by using suspensions of washed leucocytes. Sheep inoculated with the goat virus were found to suffer from severe disease. The essential importance of devising methods that are of the lowest possible cost, having regard to the enormous numbers of cattle that

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Goat Virus Vaccination.

Healthy goats.

Passage of virus.

Fourth day after passage.

(*Article by* Major R. F. Stirling, *page* 290)

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stand in need of protection and the low intrinsic value of cattle generally in India, is again discussed. The work of immunisation by this method is now being pressed forward to the utmost extent compatible with the financial resources allotted by the Government to the veterinary department. We are well aware that the use of a virus attenuated for cattle by goat passage may offer possibilities only when the cattle to be immunised already possess a relatively high degree of natural immunity, and that in other countries, and in India where specially susceptible cattle may be encountered, the method cannot be safely adopted in place of the well-known serum-simultaneous method. However, in this method the dose of serum to be administered would be much lower than that required when a fully virulent cattle virus was inoculated instead of the goat virus. The method of immunisation by the use of goat-adapted virus would seem to be the most suitable, so far as we can now judge from the experience gradually accumulating in the course of field trials, for general use upon the great mass of indigenous cattle (including also buffaloes) in India. The indications for the use of the method and the precautions to be observed are touched upon in the body of the paper, and as further experience is gained will be studied and noted down further.

(4) Acknowledgments.

In the first place our thanks in my department are due to the Government of the Central Provinces, which during a year of penury has given us every help within its power and encouraged the staff by reference to our endeavours in an official resolution. The field work has been accomplished through the loyal support of members of the staff too numerous to mention here. The records of the work and details of organisation have been kept at headquarters by Rai Saheb R. V. Pillai, and from his records these reports have been written. Mr. Pani has had executive control of nearly all field operations. Help in laboratory experiments has been obtained from Messrs. Nair, Biswas, Gopalkrishnan, and Risvi. I need hardly mention again the part taken by Dr. Edwards in making possible by his work this scheme of control, or our appreciation for his kindness in looking through our reports prior to publication, and his criticism. In a communication which I had received from Colonel A. Olver, of the Imperial Council of Agricultural Research, Simla, the statement was made: "Such observations as you describe are of course the logical outcome of Dr. Edwards' original research, and arrangements have already been made to carry out similar observations on a more extensive scale than has hitherto been feasible in other provinces." We have been always fully aware in this department of the origins of the method of control described in these reports; some of us were intimately associated with Dr. Edwards during his work and received then from him an idea of the possibilities that were laid open.

I have also to thank our veterinary colleagues in China, Malaya, Siam, Hong Kong, Australia, and Africa, for the encouraging letters received from them after the appearance of our first report, and for their kindly criticism. I wish

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in particular to thank Dr. Delpy, of Teheran, for his advice ; his remarks go to show how much the religious opinions of the millions of inhabitants of India obtrude in applying measures of disease control in animals, according to methods which undoubtedly serve well in countries differently placed in this respect.

I wish to thank here, too, Mr. McDougal, Principal of the Agricultural College, Nagpur, for helpful suggestions regarding the feeding and maintenance of cattle undergoing immunisation ; research upon this problem is still in progress. Since my first report was published, it has been brought to my notice that my colleague, Mr. P. J. Kerr, I.V.S., Director of Veterinary Services, Bengal, has been carrying out preliminary experiments on similar lines to mine, and I shall look forward to the published records of his experience for comparison of results.

Lastly, I feel I would be failing in gratitude were I not to acknowledge the incalculable help I have constantly received from my wife in making records of field operations in circumstances often of much personal inconvenience to her.

(5) Addendum.

Since the date when the above interim report was written for publication (January, 1933), I have received while on leave in England, from my staff in India, a summary of the work which has been done until now (June, 1933). Since the work of vaccination by the goat-virus method was begun in 1931, there have been inoculated (until June 8th, 1933) by the method a total number of cattle (including buffaloes) amounting to 7,435. These have all been inoculated (with the exception of 690 done by Veterinary Inspector Pillai in 1932–33) by one operator, Mr. Pani. The figures for the successive financial years (April 1st to March 31st) are :

1931–32	656
1932–33	4,962
1933 (April and May only)	1,817
Total	7,435

These have all been inoculated without fatal accident except for the five recorded in the text of the second report published above. It may therefore be concluded from these figures that we are now well under way with this method in the control of rinderpest in the Central Provinces.

The pressing need for extending the work has now been so well recognised by the Government of the Central Provinces that representations have been made to the Imperial Council of Agricultural Research in India to grant sufficient funds to enable the local government to employ eleven veterinary surgeons whole-time on this special work in the near future. If these proposals are approved it is hoped that much larger figures of inoculated cattle will be available for forthcoming reports.

SHOOTING AS A MEANS OF PAINLESS DESPATCH.

By LIEUT.-COLONEL J. W. RAINEY, C.B.E., M.R.C.V.S.
Newbury.

It was impressed upon me at an early age that an instantaneous death by shooting was the only proper way of despatching to the happy hunting grounds any horse or dog, and no distinction was made between these animals in that respect. My youth was passed for the most part in rural circumstances remote from cities, in an intensely pastoral and sporting atmosphere. This fact has, of course, no biographical interest, but it has a psychological importance, because one's views through life are affected by early impressions, and I am typical of a large number of people.

To me, and to most people brought up in similar circumstances, there is something peculiarly revolting in the idea of a lethal chamber, which is an entirely urban conception. I believe that it would be difficult to find in Great Britain or Ireland many country gentlemen or field sportsmen who would choose to have their dogs destroyed in a lethal chamber in preference to shooting the animals. To the mind of the educated countryman a rapid despatch—the most rapid possible despatch—has always seemed to be the right and due of his horse and dog at the end of their short lives. It has been left to the sentimental city dweller to introduce and practise delayed forms of killing, and to regard them as preferable in a humane way to instantaneous means which seem to his overwrought imagination to be brutal.

The common practices of mankind abound with examples of the fact that an instantaneous death is generally regarded as the most humane. The term "death" is here used figuratively, because we all know that no common form of killing is literally instantaneous. The "Poniard of Mercy," the rope, the axe, the guillotine, the bullet, and finally the electric chair, are all expressions of man's instinctive desire to be merciful in the necessary taking of life.

The ultimate boon of the tyrant was a quick, clean death. A delayed death was reserved for his worst enemies and for the greatest malefactors. A fallacy in the argument might seem to be that any delay in the older means of killing meant severe physical pain, and that a rapid despatch was, and is, desirable solely on these grounds. I will agree to that idea when I see any civilised nation or State adopt a slowly-acting gaseous poison in a lethal chamber as a means of executing malefactors. Until that happens I will think, like Agag in the Bible, that the bitterness of death lies not in its doing, but in its anticipation. It would be difficult—I think impossible—to reconcile on logical grounds the universal acceptance of the principle of instantaneous unconsciousness in the humane slaughter of cattle and horses with its almost equally universal rejection in small animals, so-called euthanasia. Large, and mainly true, books have been written in order to justify and prove the principle of instantaneous unconsciousness in the killing of animals for food. For example, that comprehensive book entitled

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" Pistol *v.* Pole-axe," by Miss Lettice Macnaghten. On the other hand, volumes of sentimental fiction have been written on the so-called putting to sleep of dogs and cats by delayed means. The practical results of the humane slaughter principles have been magnificent ; the practical results of the putting-to-sleep principles have been disastrous. If further argument is needed, who, it may be asked, would desire any sort of delayed form of death for a horse ; and if not for a horse, why for the hound ? and if not for the hound, why for the terrier ?

Training and Methods of Shooting.

And now to a practical consideration of shooting—when at once an odd reflection occurs to me. It is, that although I, personally, would not choose to destroy an animal of my own by any means other than shooting, and would for myself or my friends choose no other form of death, I am unable to recommend its general use, because of all methods its efficacy depends so much upon personal skill or aptitude where small quickly-moving animals like dogs and cats are concerned. I have seen a fully-qualified veterinary surgeon, a regular army officer, a skilful and intelligent man, completely fail to kill a horse with a service rifle at short range. I have seen others equally unable to use a revolver. It is largely a matter of personal aptitude : some can, and some cannot shoot. Practically all men, however, can be trained to use certain forms of humane killer pistols. I have never met a normal man who could not easily be trained to use a humane killer of the sort used in the Army and by knackers and butchers for killing horses and oxen—the sort one fires by a blow from a mallet, formerly called the " cattle killer," a free-bullet instrument.

The R.S.P.C.A. experts say that difficulty is sometimes experienced in training men to use the trigger-operated humane killer captive-bolt pistols for small animals. For the larger types of dog, however, such as a foxhound, any handiman can be trained to use the free-bullet humane killer safely and effectively. We know that to be true from what actually happens in hunt kennels, where hounds as a rule are shot by the kennel huntsmen in an efficient and perfectly humane way. I have been unable to hear of any considerable hunt kennels where hounds are killed in any way except shooting. In most villages there is a shooting man of the near-poacher variety who undertakes the work of shooting his neighbour's unwanted animals. His usual weapon is a 12-bore shot gun. A good shot, using this weapon up to a range of about fifteen yards, can kill certainly and instantaneously by spreading the shot around the region of the head. Two or three small shot penetrating the brain will cause instantaneous unconsciousness and certain death, so that there is a wide margin of error.

The best demonstration ever given to me of how a small bullet will cause instantaneous unconsciousness and certain death to a large animal, was on a coco-nut plantation where a large number of cattle suffering from open tuberculosis had to be killed. The planter, a crack shot, stood beside me in the midst of about 100 cattle in a small paddock and asked me to point out the diseased beasts. Using

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a .22 calibre rifle, fitted with a silencer, he rapidly picked off about a dozen beasts with complete accuracy at ranges up to 25 yards one after another, so that each beast fell dead with one tiny bullet in the brain. The report was so deadened by the silencer, and it was all done so quickly and cleanly, that the other cattle did not take alarm. Every bullet had entered the skull just about where the hair curls on the centre of the forehead.

For shooting dogs in towns, a shot-gun is out of the question, and a .22 calibre free-bullet pistol or a captive-bolt pistol must be used. From custom, and for other reasons, I prefer the ordinary free-bullet pistol.

If one can, it seems to me more ideal to kill the animal without forcibly restraining it, and this can only be done with a free-bullet weapon. For some years in an East London practice I used this method exclusively for dogs. My technique was to take the lead in the left hand and my pistol loaded and cocked in my right hand, and walk with the dog across the yard into a shed, and then quietly and patiently wait for the moment when I could direct my bullet either through the centre of the forehead, well above the eyes, or behind the ear towards the opposite eye. It could not always be done at once, but with few exceptions it could be done without arousing the apprehensions of the animal.

In the pocket of my operating coat there was ready a syringe charged with 5 c.c. of prussic acid, and as soon as the dog fell it was injected into the thorax. I regarded this as a necessary procedure where a small calibre bullet is fired from an ordinary pistol, because one can never be absolutely certain with dogs as to the direction taken by the bullet after it pierces the skull, and without this precaution I have seen indications in some instances of returning consciousness. One of the greatest difficulties in the shooting of dogs with an ordinary pistol is the way some dogs will look up into the operator's eyes as he tries to point the pistol, thus opposing the forehead at an acute instead of a right angle to the direction of the shot. Unless the bullet strikes the bone at somewhere near a right angle to the axis of its direction, there is always the risk of more or less deflection, however true the aim may be. This fact accounts for the true stories one hears of complete failure to kill or even stun the animal; the bullet has struck the skull at an acute angle and glanced off again.

The captive bolt pistol is superior in this respect because the bolt cannot be deflected so easily from its course. On the other hand, it is necessary when using the captive bolt pistol for some dogs to apply a forcible restraint, which to some extent excites apprehension and fear, and then the operation is not true euthanasia.

It was on this account that after trial I discarded the "Greener Safeti-killer Pistol." With this weapon one has to push rather hard against the dog's head to contract the spring and make contact between the cartridge and the striker; the apprehensions of any intelligent dog are thus aroused. Such a weapon does very well for unsuspecting animals like sheep, but it is of less use for

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euthanasia of the dog (I do not touch the dog's head with the pistol). Other forms of humane killer pistols are mentioned in the following appropriate and useful quotation from an official R.S.P.C.A. report :

" In the shooting of cats, the animals are gently lifted out of the baskets in which they are brought to the League, by the scruff of the neck near the head, the under part of the head is then placed on a rubber-pad covering wood, and the cats are shot with a small Temple Cox killer placed so that the bolt penetrates the centre of the brain, which is half way between the front part of the ears. Dogs are also shot through the centre of the brain, which is similarly situated as in cats, and great care is taken to handle the dogs gently beforehand, and give them time to get quieter when agitated before applying the pistol ; the operator stands at the side of the animal behind its eyes and brings the pistol over from the back of the head, so that the animal if ' gun-shy ' cannot suspect that he is about to be shot. Observations are made after shooting dogs or cats to ensure that the bolt has passed through the major brain, thereby avoiding any risk of a return to consciousness. No animal is removed from the premises until it is stiff (rigor mortis). Small dogs are shot with the little killer used on cats. Larger ones with the Cash pistol or the quiet New Universal of the Temple Cox Company."

I find on referring to veterinary literature upon the subject that I am not alone in my preference for the free-bullet pistol. Dr. W. A. Young, D.V.M., the chief veterinarian of the Animal Rescue League of Boston, Massachusetts, in an address delivered to the American Humane Association Convention, at San Francisco, in October, 1932, says in regard to captive-bolt pistols : " The Temple Cox Killer, such as is used in England, I consider entirely out of the question in so far as this question of destruction of small animals is concerned. There are two reasons for my position. First, the range of the weapon is only three or four inches, in other words, the distance that the bolt travels. This means that whenever, and some day it will happen, an animal moves away a little bit just at the moment of pulling the trigger, you will not kill the animal, only wound it. Second, when this happens there is no repeating feature to the weapon. It necessitates considerable manipulation to get it re-loaded, during which time you can well imagine what would happen to a dog, cat, or horse that had been injured and not killed. There is no particular advantage of this weapon over shooting, and there are many advantages of the pistol over the Temple Cox Killer."

So far as the animal is concerned, and that is what Dr. Young has in mind, I agree with much that he says, but in the wholesale destruction of dogs by subordinate personnel one must admit that the captive-bolt pistol lessens the risk of accidents to human beings. This risk, however, in intelligent trained hands is negligible. Full information of the details of the various sorts of pistols and their uses is given in the above-mentioned book, entitled " Pistol *v.* Poleaxe," which is

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introduced to the veterinary profession in a sensible preface by Professor R. G. Linton, of the Royal Dick Veterinary College.

I can add nothing to the information given in that book concerning humane killer-pistols. In my own experience, however, in military and Colonial veterinary practice, I have always preferred for killing horses and oxen the .450 Webley revolver (long barrel) to any sort of humane killer. It is more portable and practicable for use when one has to destroy frightened or semi-wild animals in routine veterinary field work, and one comes to prefer it for one's own use to any humane killer. Complete instruction in the practical use of a revolver is in my opinion an essential part of the training of a Colonial or military veterinary officer. Even under peaceful conditions in Colonial service, one is sometimes called upon to destroy animals in circumstances where an inability to use a revolver in a workmanlike manner detracts from one's professional and humane usefulness. Sometimes with untamed cattle in rough country, I have had to aim for the heart instead of the head, but have never seen a beast drop instantaneously when this was done; there was always a considerable interval of conscious distress before the animal fell.

Shooting in Veterinary Practice.

Veterinary practitioners are in many places debarred to a great extent from shooting as a lethal means in their practices. There are several practical difficulties about shooting which in some places, and at some times, are insuperable. In the country, with sporting clients, the veterinary practitioner who can shoot horses and dogs skilfully is appreciated, but it is difficult to imagine that a similar skill in Kensington in regard to cats would be hailed with enthusiasm. The reflex actions of a cat shot in the brain alone have to be seen to be believed. Even in East London, where the *clientèle* are not usually fastidious or exacting, one gained the impression at times that there was a feeling that shooting was rather too quick and easy for the money.

There is also always the " blood " difficulty. Profuse bleeding often follows an apparently well-placed bullet, especially from the nostrils. Where shooting is impracticable it seems to me that the obvious humane alternative is electrocution or electric stunning. Failing either of these means I am unable to discover what advantage a gaseous lethal chamber has over the proper administration of fresh double-strength prussic acid. If we are to disregard, as no evidence of suffering, the obvious distress during the comparatively long induction stages of gas and chloroform poisoning and the howling which so often occurs at the time of collapse, it seems to me that we may with even better reason (on account of its brevity) disregard the similar phenomena which accompany prussic acid poisoning. For my part I confess myself unable to discriminate between these phenomena so as to know certainly that *this* is conscious, and *that* unconscious, distress. To me, after very long and varied practical experience, apparent distress and howling in animals about to die, be the cause what it may, are repugnant, and, like Professor Linton, I regard any attempt to distinguish between the degrees

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of suffering in those states as futile, because we never can and never shall know the truth. Consequently, I prefer a means which obviates those unpleasant phenomena and relieves my mind of all doubt on the subject. Such a means is at hand in shooting, for those who have the aptitude and the facilities to use it.

THE APPLICATION OF ELECTRICITY TO EUTHANASIA IN DOGS AND CATS.

By CYRIL R. GOLLEDGE, M.R.C.V.S.

Trowbridge, Wilts.

In consequence of the publicity which has recently been given, both by the lay and veterinary press, to the humane destruction of dogs and cats, the following article on the most modern aspect of the subject would not appear to be out of place in this Humane Edition of the Journal. One has only to peruse recent publications on the lethaling of dogs and cats to realise that methods generally in use at the present time are not only unsatisfactory, but savour of antiquity, and the appointment of a veterinary committee to investigate the matter indicates that the profession has at last realised its responsibility in this direction.

The use of electricity as a lethaling agent is by no means new, and numerous contributions have appeared in this and other veterinary papers regarding the electrical stunning of pigs prior to sticking. This was first perfected by Professor Müller, of Munich, and introduced into this country in 1931 by Professor Sir Frederick Hobday, since when it has been used with great success in a number of slaughter-houses, and it is to be hoped will soon be universally employed. It is not until recently, however, that the possibilities of electricity for the humane destruction of dogs and cats have been thoroughly explored. Several firms have manufactured and placed on the market various appliances for electrocuting these animals, but all that have come to my notice have been too cumbersome, unpractical and expensive for general adoption.

Having long been very dissatisfied with the existing methods of disposing of my clients' pets, I recently started to investigate the properties of electricity when applied to lethaling the smaller animals. Since it had been established that a direct current of only 60 volts, interrupted at the rate of 3,000 times per minute, when passed through a pig's head for ten seconds, not only produced immediate unconsciousness, but rendered the animal unconscious sufficiently long for it to be stuck and bled after the current had been switched off, it appeared likely that a similar application of current (using for convenience alternating instead of interrupted direct) followed by an intra-thoracic injection of prussic acid might prove effective with regard to dogs and cats. It was realised, however, that owing to these animals having highly developed nervous systems, and in some instances heavy coats, a current of considerably higher voltage might be necessary

to produce the desired effect, and in consequence a start was made, using about 200 volts, derived from the main supply, alternating at fifty cycles per second.

Form of Apparatus.

The apparatus used was originally home-made, but since it can be manufactured for quite a moderate sum, I have now had a slightly more elaborate model made. It consists of a pair of tongs which can be easily manipulated with one hand, and a special switching device which can be held and operated while holding or steadying the animal with the other hand, this having been found to be advisable to obviate any chance that the tongs may become misplaced and contact impaired owing to the sudden stiffening of the animal which is produced when the current is switched on. The tongs carry spiked electrodes, specially constructed and hinged so as to accommodate themselves to heads of different shape without causing discomfort; pads of cottonwool or sponges soaked in 20 per cent. salt solution being inserted between the spikes to insure proper contact.

Showing the apparatus and method of application.

Preliminary Experiences and Technique.

The effect of this current was first tried on some four-day-old pups, and the result was so satisfactory that it was decided to attempt the destruction of an adult dog in the same way. This was also successful, the animal relapsing into unconsciousness directly the current was applied, and remaining in this state until death supervened. It was noticed, however, that when the current was switched off and the injection of prussic acid was made, that the respiration which had been in abeyance during the time the current was applied, recommenced and continued for a short time, although there was no evidence of consciousness being regained, and no response to the corneal reflex. Several other animals were destroyed in the same way, and although it was obvious that there was no return of consciousness in any of them, it was found that some not only recommenced breathing, but actually started to simulate walking movements with their limbs. Since it was thought that this reflex movement and the resumption of breathing would not favourably impress owners who particularly wished to

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see their pets " put to sleep," an attempt was made to obviate it. It appeared likely that the prussic acid was in some way responsible, and that it did not diffuse over the body as quickly in an animal which had been anæsthetised by an electric current as it would in one breathing normally, and it was decided to make the injection of prussic acid while the current was being applied (5–10 seconds after the current was switched on), and to apply the tongs for a longer period 20–30 seconds). This alteration in technique overcame all obstacles hitherto encountered, in that it prevented the resumption of respirations, and in most cases other reflex movements were entirely absent. To quote the words of Lieut.-Colonel Rainey, to whom I gave a demonstration, and who has since published a very comprehensive work on small animal euthanasia : " I can now state definitely from personal observation that Mr. Golledge's method is a perfect and practicable form of euthanasia."

To administer the current, the tongs are applied to the animal's head so that the electrodes make contact on either side just in front of the ears, it being advisable thoroughly to damp the skin at the points of contact prior to applying the tongs. Since contact is made with the animal while the current is being applied, the operator should wear rubber gloves. In practice, however, I have only found it necessary to wear one on the left hand, this being the one used for holding the animal. Either hand can, of course, be employed for this, but as it is essential to apply the tongs with especial care to prevent exciting or causing discomfort, I always do so with the right hand. Assuming this to be the case, the operator stands on the right side of the animal and places the tongs in position from above, grasping them so that the thumb is farthest away from the body, thus making it possible for the animal to drop on to its right side without twisting the operator's wrist. (For convenience, large dogs are lethaled on the ground, while for cats and small dogs a non-conducting table is preferable.) Having placed within easy reach a suitable 5 c.c. hypodermic syringe fitted with a long, stout needle and filled with prussic acid (Scheele's), and having secured the animal with the left hand (in which one holds the switch) and applied the tongs, the current is switched on. At the same instant it is advisable to tighten the grip of the tongs, which hitherto should have been applied lightly, so as to insure perfect contact. Having released the hold with the left hand and dropped the switch, the injection of prussic is made, and when it is noticed that there is slight relaxation of the spasm produced by the current at the onset of its application, usually occurring in about twenty seconds, the tongs are removed and the current switched off.

Effects of the Current.

The head is immediately tilted slightly backward, the eyelids are tightly shut, the animal drops into a sitting position, and is allowed to fall on to its right side, where it lies perfectly still with legs rigid and extended. An exception to this is sometimes encountered in the case of cats, which often first crumple up and do not stiffen for one or two seconds. Cardiac and respiratory movements

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cease immediately, but the former recommence just before or after the tongs are removed. Emptying of the bladder occurs in many cases, but defæcation is rare. Sudden relaxation of the whole musculature of the body follows removal of the tongs, the eyes open, and apart from a percentage of cases in which the hind limbs re-stiffen and one or both may be drawn slightly forward, there is no other movement. The whole procedure is entirely free from noise, animals rarely resent the application of the tongs, and the results are so spectacular that all owners who have seen their pets destroyed by this method have been very impressed, and have remarked on its superiority to the lethal chamber and other methods.

The Effect of Using Lower Voltage.

In view of the success attending the use of a considerably higher voltage than that employed for pigs, I decided to try the effect of a weaker current, and it will be seen from the following observations on ten consecutive cases, half of which were destroyed by the original, and half by a voltage approximating to that used for pigs, that the reduction in voltage was inadvisable :

	Original Voltage.	Voltage reduced to 100 Volts.
Time during which current was applied (average)	22 sec.	31 secs.
Period between application of current and injection of prussic acid (average)	9 sec.	9 sec.
Period between cessation and resumption of heart beat (average)	20 sec.	31 sec.
Time renewed heart beat continued (average) ...	1 min. 53 sec.	3 min. 6 sec.
Presence of corneal reflex	*Nil*	2
Presence of slight movement of one or both hind legs	3	3
Presence of exaggerated movements	*Nil*	1
Entire absence of movement	2	1
Resumption of respiration following removal of tongs	*Nil*	2
Emptyin$_{\text{g}}$ of bladder	3	3
Defæcation	*Nil*	*Nil*

Effect on Consciousness.

As to the way in which unconsciousness is produced, opinions seem to differ. Some assert that cerebral anæmia is the cause, while others argue that this is impossible on acccount of the immediate rise in blood pressure to about three times the normal when the current is applied. Professor Müller considers that unconsciousness is due to arrest of the brain circulation, and it seems reasonable to suppose that this may be correct, since the sudden and complete stasis of the circulation following cardiac failure must lead very rapidly to a condition of un-

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consciousness. As far as can be judged, however, loss of consciousness appears to be induced instantaneously; and it has been suggested (and is probable) that there is some other contributing factor such as shock or convulsion.

Conclusions.

Having to date destroyed well over fifty dogs and cats with the original voltage, I am convinced that it is a most efficient and humane method of destruction, and can recommend it with every confidence. There are still a few who are inclined to doubt whether the current produces unconsciousness, or only a state of paralysis during which the animal is unable to move or give evidence of feeling pain; but since this has been investigated, in the case of pigs, by Professor Sir Frederick Hobday, Professor Leonard Hill and Professor Legge Symes, and they have expressed the opinion that true anæsthesia is produced, it would appear unnecessary to discuss the matter in this article. I have had the pleasure of demonstrating my method to several eminent veterinary surgeons, and not one has expressed the slightest doubt that unconsciousness is immediately produced and sustained until death supervenes. Although, as illustrated in the above observations, a voltage suitable for pigs is apparently not satisfactory for dogs and cats, it is possible that if the frequency of the alternations were increased, or an interrupted direct current used, the lower voltage might prove efficient. Personally, however, I very much doubt whether this would be the case, and as it would necessitate the use of a far more expensive apparatus, I have not considered it worthy of trial.

Electrically-produced anæsthesia has been successfully employed for operations of short duration on pigs,* and its use may be extended to embrace other animals; but in view of my experience that a considerably stronger current is essential properly to anæsthetise dogs and cats, the possibility of bone fractures and impaired mentality following its use make its practicability doubtful. As advocated by me, its use is restricted to the instantaneous lethalisation of dogs and cats, with a view to providing such animals with an unexpected death, entirely free from pain, an accomplishment difficult to attain with certainty by any other method.

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* VETERINARY JOURNAL, 1932, page 454.

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THE HUMANE SLAUGHTERING OF FOOD ANIMALS.

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In England and Wales the slaughtering of food animals by mechanical means continues to excite bitter controversy. It had been pointed out from time to time that the question of the best means of slaughtering pigs is one that requires special attention in view of the fact that the flesh of these animals is preserved or " cured " after slaughter, and is not consumed until some months later. It was for this reason that bacon curers opposed the use of the pistols for the stunning of pigs, as they maintained that the resultant blood extravasation into the tissues caused serious damage to the bacon. In spite of their opposition to the pistol, some progressive curers realised that it was always possible to improve upon existing methods, and they welcomed and assisted experiments designed to that end. The introduction of Müller's electric method of stunning into England in 1929, on the advice of Professor Hobday, raised great hopes as far as the stunning of pigs was concerned, and, although those early attempts at the use of electricity for this purpose proved useless, further attempts were made with a much improved instrument, and the success of this new method of stunning by what is termed " The Electrolethaler," is now beyond question.

The flesh of cattle, calves, sheep and lambs, is generally consumed within a few days of slaughter, when the meat is in the fresh state, so that any blood extravasation or " splashing " in the tissues of such animals is of comparatively slight account, and is unnoticed by the consumer. Mechanical stunning instruments can therefore be used on such animals without any danger of causing damage to the meat and rendering it unsaleable. As far as the slaughtering of cattle is concerned, I have had no experience of the use of Müller's electric stunning in this connection. I am given to understand that the method needs perfecting yet before it can be generally adopted for use on cattle. Although, therefore, unable to express an opinion upon the matter, I can claim some experience in the use of the pole-axe and the Cash Captive Bolt pistol for the stunning of cattle. The serious drawback to the use of the pole-axe is that, with the " American Box " method of restraint, it requires one man to steady the animal's head, whilst the other wields the pole-axe. The time wasted in manuœvring the animal into a suitable position, and the possibility of the beast moving its jead just as the axe is descending, resulting in a blow which does not penetrate the brain nor stun the animal, and then having to repeat the operation, all counts against the utility of the pole-axe.

With the Cash Captive Bolt pistol there is no necessity for one man to steady the animal's head. The operator simply places the muzzle of the pistol on the exact spot over the brain and pulls the trigger. Here we find the pistol a vast improvement on the pole-axe, and whilst it is true there is an increased expense in ammunition, yet this is compensated for by the rapidity with which beasts

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can be stunned, and by the fact that one man can be released from steadying the animal's head, to perform some other work.

One is bound to encounter a good deal of opposition and prejudice in introducing a new method of slaughtering, but so far as our slaughtermen are concerned, *they would not revert to the use of the pole-axe for stunning cattle under any circumstances.* We have slaughtered some thousands of beasts with the Cash Captive Bolt Pistol, and find it satisfactory in every way. As far as the stunning of calves, sheep and lambs is concerned, there is no reason why the pistol could not be used in this connection also, but in my opinion an even better method is the use of the electrolethaler, the same instrument being used as for pigs. The advantage of the electrolethaler over all other stunning instruments is that it is an instrument for the production of anæsthesia, and does not necessarily result in death. An electrolethalised animal can be allowed to recover if necessary, whereas it is obvious that a shooting instrument can only result in the death of the animal, irrespective of any bleeding. The bleeding operation that usually follows stunning by shooting is performed solely in order to drain blood from the carcase, so that the meat will keep better, and is not done in order to produce death, the shooting itself having already done so.

With the electrolethaler, bleeding is essential in order that the animal may die. *The lack of violent reflex movements in an electrolethalised animal enables the bleeding to be done with perfect safety to the operator, whilst the amount of blood drained from the carcase is also increased,* thus enabling more of this useful by-product to be manufactured into blood meals, fertilisers, etc., the animal being unconscious the whole time. For the stunning of pigs I know of no instrument that is so effective as the electrolethaler. In 1932, I reported upon its use on about 15,000 pigs. Since that date I have experienced this instrument in use on about 200,000 animals, mostly pigs, with calves, sheep and lambs also, and I am more than ever convinced that it is the ideal method of producing unconsciousness in these food animals.

In a large factory such as this we have certain advantages over those meat traders who have to do all their killing in a public abattoir. Here we can place these stunning instruments in the hands of trained operators, who soon become experts in their use. This results in the minimum amount of damage being done to both instruments and carcases. In public abattoirs, however, it is at present not possible to do this, and every salughterman, however incompetent, claims the right to use the instruments provided, with the result that they soon become damaged and useless. The only disadvantages I have found with the use of the electrolethaler are that if the current is kept on for too long a period the backbone is liable to be fractured, and so is the scapula. This can be prevented by giving a minimum application of current, which an expert operator can soon learn to do. Another slight disadvantage is the " splashing " or blood extravasation into the lungs. The lungs of pigs which have been subjected to the electrolethaler may show some dark-red blood spots. This is a minor disadvantage, as lungs are

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chiefly sold as cat's meat, and the spotted parts can invariably be cut off by the inspector, and the remainder of the lung passed, if the unsightliness is considered objectionable.

The advantages of the use of this instrument for pigs, sheep and calves far outweigh these minor disadvantages. In the first place the pigs do not require any method of restraint. It was thought that some form of trap, such as the Van Dorp, would be required in conjunction with the electrolethaler, but it was found best in the interest of the animal itself to do away with such methods of restraint, and to simply drive the pigs quietly into the " hoisting pen." The electrolethaler tongs are immediately clamped on the pig's head, and the current turned on, with the result that the animal is rendered unconscious before it has had time to realise that anything untoward is happening. *There is no handling by human agency, as this handling which so often accompanies the older methods of pig slaughtering is the cause of more squealing than the operation of bleeding itself. Thus pig killing by the electrolethaler is silent. There is nothing to frighten the animal,* no noisy iron traps, narrow passages with floors dropping out, but simply a clean pen with plenty of clean wood shavings on the floor, so that the carcase is in no way damaged when the pig falls unconscious.

The advantages of the electrolethaler are not solely confined to freedom from noises during slaughtering. The lack of violent reflex movements during bleeding I have already mentioned, together with its advantages as far as the blood draining is concerned. In the case of hoisted pigs that had been shot, the violent reflex movements were a frequent cause of rupture of the muscles of the hind legs, resulting in damaged hams. This, which was a serious matter where hams were the main consideration, as is the case in some factories, does not occur when the electrolethaler is used as the agent to accomplish the stunning.

It is gratifying to note that the electrolethaler is being adopted by an increasing number of local authorities throughout the country, as well as by private firms, and even butchers in a comparatively small way of business. In an area crowded with human population it is a great blessing to have pigs slaughtered in silence, whilst the fact that the R.S.P.C.A., following out the result of the test made here by a Committee consisting of Sir Leonard Hill, Professor Symes and Sir Frederick Hobday, have now approved of the use of this instrument for pigs, is also gratifying. It is to be hoped that this Society will also encourage the extension of its use to lambs, sheep and calves, and so help to put an end to the barbaric method of throwing a little lamb on to a bench, " sticking " a knife into its throat, enlarging the wound by the finger, then suddenly wrenching its head backwards to " break its neck," as is so common in most slaughter-houses in this Christian country !

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THE TRANSMISSION OF LOUPING-ILL OF SHEEP BY TICKS.*

(*Rhipicephalus appendiculatus*).

BY

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THE difficulty of effectively combating some of the virus diseases of domesticated animals in South Africa has indicated that a comparative study of some other virus disease such as louping-ill of sheep might yield beneficial results. Louping-ill appeared suitable for the reason that the virus is easily transmitted to mice, the recovered animal develops a solid immunity, and ticks appear to be the important vector Amongst others, Gordon and his co-workers[1] direct attention to the association of the tick *Ixodes ricinus* with louping-ill. In summarising the available literature these authors point out that circumstantial evidence favours the view that the British tick *I. ricinus* plays an important rôle in transmission, but quote conflicting opinions from two sets of workers, namely, Greig,[2] *et al.*, and Stockman,[3, 4] as to the nature of the disease transmitted by ticks to sheep in their experiments.

In a more recent article, MacLeod and Gordon[5] detail careful experimental work on the transmission of both louping-ill and the so-called tick-borne fever by nymphal and adult *I. ricinus* that had fed on reacting sheep during the previous stage. This work appears definitely to establish the significance of the tick in the epizootology of the disease. The object of this preliminary report on the successful transmission of louping-ill by means of *Rhipicephalus appendiculatus* is to put forward direct experimental evidence of the association with the disease of ticks other than the genus Ixodes, in the hope that it may be of value to other workers engaged in the investigation of the many associated problems.

Virus.—The virus used throughout these experiments was placed at the disposal of the authors by J. H. Mason, to whom we acknowledge our indebtedness. Originally the strain was obtained from W. S. Gordon, Moredun, and was brought to South Africa in the form of a desiccated powder of infected sheep brain sealed in phials. This material, after storage in the refrigerator at $\pm 4°$ C. for approximately twelve months, appeared to have lost little of its original virulence for mice on intracerebral inoculation. From mice it was early transmitted to sheep by either the intracerebral or subcutaneous route.

Ticks.—The ticks used were the progeny of several *R. appendiculatus* which had been collected as fully engorged females from cattle at Kaalplaas, one of the farms attached to this Institute, and were being reared as a routine procedure

* Received December 5th, 1932, but held over by request of the Authors.—ED. VET. JNL.

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in connection with investigations into other tick-borne diseases. The females were collected on 15/2/32. Oviposition commenced on 24/2/32, and the larvæ commenced to hatch on 1/4/32. During this time they were kept in cottonwool-plugged test tubes, in jars containing a small amount of sand moistened with salt water, and were removed only as required. There can be no question that these ticks had never been in contact with the virus of louping-ill. In spite of the fact that it has been shown by one of us[6] that the bovine appears to be fully susceptible to louping-ill, the cattle from which the adult ticks were removed had been under careful observation for many months, during which time temperatures were taken every morning and no deviation from normal health had been noticed. In addition the disease does not occur in the field in South Africa. Moreover, a portion of this batch of larvæ when fed on ox D.O.B. 4694 failed to produce any febrile disturbance.

Experimental Transmission by Ticks.—On 23/8/32, two sheep (Nos. 27598 and 34070) were injected intracerebrally with 0.5 c.c. of a 1 : 500 emulsion of infective mouse brain in saline. The operation was carried out after trephining under full chloral hydrate anæsthesia. On 25/8/32, the temperature of sheep No. 34070 rose abruptly to 107.2° F., and the animal died on 28/8/32. The course of the reaction in sheep No. 27598 was similar, death occurring on 29/8/32. The brains of these two sheep were removed with aseptic precautions, and after mincing in a Latapie mincer were desiccated over P_2O_5 in vacuo at 4° C. This desiccated brain material has served as a source of virus in many experiments, and has lost little of its virulence up to the time of writing.

On 31/8/32, 5 c.c. of a 1 : 500 emulsion of this powder was injected subcutaneously into sheep No. 34115. From the accompanying temperature chart No. I, it will be seen that the temperature rose sharply to 106° on the 3rd, and with the exception of a remission to normal for forty-eight hours from the 6th, remained approximately at this level until the 12th, when it returned to normal, and no further thermal reaction occurred during the ensuing two months. At no time did any symptoms of nervous derangement make their appearance in this sheep, but blood injected intracerebrally into mice in a dilution of 1/10 in saline on 5/8/32 produced typical symptoms, with death on the sixth day.

Immediately the first rise in temperature in sheep No. 34115 was recorded, numerous *R. appendiculatus* larvæ were placed on the right ear, a bag being tied over the ear to serve as a protection and as a receptacle for any which might drop off. On examining the bag on the following day, all the larvæ were found to have attached and many were plainly visible on the ear. Daily observations showed that normal engorgement was proceeding, and from the 8th to the 12th fully engorged larvæ were collected from the ear-bag, about 800 specimens in all being obtained. These engorged larvæ were placed in cottonwool-stoppered test tubes over moist sand as before, and were left at room temperature ($\pm$20° C.). On 29/9/32, these larvæ commenced their moult to nymphæ. On 7/10/32, sheep No. 32241 was infected on both ears with about eighty nymphæ. The ticks

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attached readily, but the rate of engorgement was variable, so that fully engorged nymphæ continued to drop from the 14th to 24/10/32.

On 12/10/32, *i.e.* five days after tick infestation, the temperature of the sheep rose abruptly to 106°, and remained considerably elevated until 17th, when it returned to normal. An exacerbation of four days' duration followed from the 21st. No symptoms other than a diarrhœa and those directly attributable to hyperthermia occurred either during or subsequent to the fever reaction. However, blood drawn on the second day of fever proved fully virulent for mice on intracerebral injection in a dilution of 1 : 10 and 1 : 20. All injected mice showing typical symptoms of paralysis and dying on the fifth to seventh day.

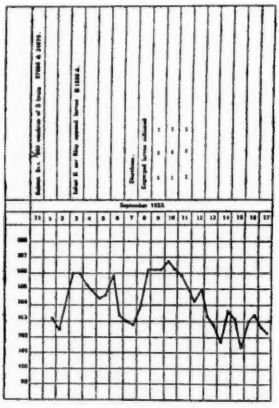

CHART I. Sheep No. 34115.

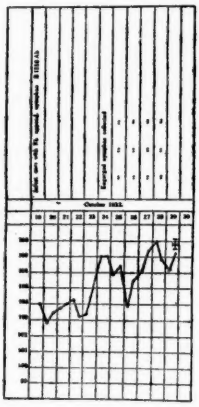

CHART II. Sheep No. 34787.

This experiment was repeated on October 19th, with the result indicated on the accompanying Chart No. II. It will be seen that the first rise in temperature occurred on the fourth day after tick infestation, and that death occurred on the tenth day. This animal, sheep No. 34787, commenced to show typical symptoms of louping-ill on the day before death. These symptoms comprised a progressive inco-ordination of movement, twitching of the muscles of the limbs, spasmodic chewing movements of the jaws, and a tendency periodically to stagger in a circle. This was quickly followed by first a paresis, and then a paralysis extending from behind forwards. Finally, the animal became prostrate, and exhibited galloping movements of the limbs at irregular intervals. Full consciousness appeared to be retained until immediately before death.

The brain was shown to be virulent for mice in a dilution as high as 1 : 5,000 on the intracerebral injection of 0.05 c.c. In addition to the transmission of louping-ill to two sheep by the bite of infective nymphæ, as shown above, two other sheep were infected by the injection of nymphæ (three nymphæ each) emulsified

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prior to and immediately after engorging. Both these sheep showed typical louping-ill reactions to which they succumbed, and brain emulsions after death were shown to be infective for mice.

Discussion.—It may be taken as clearly shown that *Rhipicephalus appendiculatus* is capable of transmitting louping-ill in sheep from the larval to the nymphal stage. No information has been obtained as yet in regard to the transmission by other stages, but detailed investigation into all aspects of transmission by this and other species of tick is in progress, and will be reported on at a later date. There can be no doubt that the disease transmitted actually was louping-ill, because apart from the almost typical temperature curve, the peculiar clinical picture of affected sheep, and the confirmation of Gordon's observations on the presence of the virus in the blood during the febrile period, it was found that the serum of recovered sheep No. 32241 was capable of neutralising at least 500 minimal infective doses *in vitro*. The serum of neither Bluetongue nor Heartwater recovered sheep was found to possess any virucidal properties. The details of these experiments on *in vitro* neutralisation and their application will be reported on at a later date.

No evidence was obtained of any life cycle in the development of the virus in the stage of the tick succeeding that which partook of an infecting meal. As soon as it was thought that the nymphæ were sufficiently mature to permit of their being able to attach to an host, *i.e.* ten days after moulting, they proved to be capable of passing on the infection. This confirms MacLeod and Gordon's observations with *Ixodes ricinus*.

It is, however, worthy of note that the virulence of the virus after passage through the tick appeared to be considerably enhanced in that subcutaneous injection of an emulsion of infective ticks resulted in the death of four out of four sheep infected in this way. The experience of other workers (Gordon, *et al.*), and our own experience with a few sheep under similar laboratory conditions, has shown, on the other hand, that subcutaneous injection of infective brain emulsion is followed by a fever reaction of variable severity, but usually not fatal. Further, there was no evidence of transmission of tick-borne fever, so that it would seem that, at any rate with *R. appendiculatus* as the vector, that disease is not necessary for the appearance of symptoms of nervous derangement.

Summary.—(1) *Rhipicephalus appendiculatus* is capable of picking up the virus of louping-ill as larvæ and transmitting it as nymphæ. (2) The virulence of the virus appears to be enhanced on passage through this tick. (3) The presence of the virus is demonstrable in infected ticks before and immediately after engorging.

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THE BREEDING HEN WITH A CROOKED KEEL.

By A. P. BLOUNT, F.R.C.V.S.

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In a recent issue of the *South African Poultry Magazine*, Vivyan, in an article entitled "Should we Discard the Breeding Hen with the Crooked Keel?" puts forward the theory that the domestic hen, through change of environment, is passing through a stage of degeneration of the wings and their correlated parts, *i.e.*, wing bones, breast muscles and keel.

The salient features of the article are as follows: (1) "When man determined to domesticate the hen he provided her with shelter and an abundance of food which rendered the use of the wings negative . . . and they have therefore become useless appendages." (2) "If we examine the keels of our most prolific hens we find that they invariably have the crooked keel." (3) "When a part or structure of a body becomes useless, Nature, in a very discriminating manner, proceeds to eliminate it. Such portions or structures of the body then undergo a struggle for existence, because the nourishment borne along in the blood stream is extracted by those other tissues which are rendered more avid or greedy by use, until at last these useless portions perish and disappear from the individual." (4) "If we next examine the breast muscles—the motive power for wing movement—we find that the flesh of the domestic hen is pale in colour, soft and stringy, denoting a diminished flow of blood to these parts." (5) "At birth the skeleton of the chicken is perfect in shape . . . when the skeleton of the fowl is examined, it is found that the keel is gnarled and twisted, the wing bones are pale in colour." "These parts are correlated, and represent useless appendages which the fowl has no longer need of. How are we to account for this neglect if it cannot be accounted for through the retrograde development or the degeneration of the wings?" (6) "If my theory is the true solution . . . the high producing hen should not in future be condemned as unfit for the breeding pen because she has a twist in her keel."

Unfortunately the arguments herein outlined appear to the writer to be unsound. The three factors—breast muscles, wing bones and keel—will be considered in turn. In the first place, to assume that the breast muscles of the domestic hen are pale because of a diminished flow of blood to the parts is incorrect. Surely the fact that these muscles are capable of normal development, even in hens which may lay over 300 eggs in twelve months, indicates the very opposite of a localised muscular anæmia, since the total weight of the pectoral muscles in healthy mature pullets is usually equal to or more than that of the whole of the remaining muscles of the body combined together. Also the breast muscles of hens are very much more developed than in jungle fowl. As a fact, physiologists have taught for years that there exist two normal types of *voluntary* muscles (under the control of the will), *i.e.*, red and white (pale pink), a fact which Vivyan does not seem to have appreciated. The classical examples of the latter being the gastroc-

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nemius and adductor magnus muscles of the hare and rabbit, and the pectoral (breast) muscles of the domestic hen. Such muscles differ from ordinary red voluntary muscles both anatomically and physiologically. Their more pale appearance is not due to a diminished blood supply, but to their increased complement of sarcostyles and subsequent diminished amount of sarcoplasm, which latter contains normally a red colouring matter (pigment) termed myoglobin (myochrome : myohæmatin), which is closely allied in composition to the respiratory blood pigment hæmoglobin. Not only does the leg of the rabbit contain certain muscles which are pale compared with the majority of the limb muscles (and comparable to the pale breast muscles of the hen), but certain voluntary muscles are known to consist of both red and white (pale) muscle fibres. It has been shown that these subcutaneous " red muscles " in the case of the salmon are definitely degenerate compared with pale muscles, which is therefore contrary to Vivyan's hypothesis. It has been shown chemically that the pale breast muscles of *Gallus indicus* develop more lactic acid than the leg muscles of the bird, and also that the pale leg muscles of *Lepus cuniculus* develop more lactic acid than their red associates (0.71 per cent. compared with 0.62 per cent. ; the percentage for the pectoral muscles of hens is even higher). These and other facts indicate that red muscle possesses more oxidising ferments than white muscle, and obviously cannot mean that the latter muscle is degenerate or anæmic. In response to a single electrical stimulus pale voluntary mammalian muscle responds more rapidly than red muscle, which indicates an activity which would hardly exist were these muscles receiving a diminished blood supply. Further, if an anæmia were present the affected breast muscles would hardly be expected to contain more potassium sodium and phosphorus, which the following figures show to be the case :

Fowl (*Gallus indicus*)	K.	Na.	P.
Skeletal white	410	89	251
Skeletal red	373	77	241
Stomach	356	72	182

The physiological position of the various types of muscle can be summarised thus : *Intestinal muscle.*—Non-striated, pale, involuntary, slow, frequently sustained. *Gizzard muscle.*—Striated, red, involuntary, slow, more intense, capable of being sustained. *Heart muscle.*—Striated, red, involuntary, rapid, sustained. *Breast and leg muscles.*—Striated, red, voluntary, rapid movement, easily fatigued. *Breast and leg muscles.*—Striated, white, voluntary, less rapid movement, less easily fatigued.

In considering the function of breast muscles of birds of the same size, attention must be paid to those animals which *flap* their wings (pigeon and kestrel), and contrast these with birds like seagulls and falcons, which *soar*, for in the case of the latter the pectoral muscles are frequently involved in positions termed " posture." Similarly, birds which fly and feed on the wing (swallows) should be compared with humming birds, which feed from the ground or in trees.

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In the second place it is incorrect to assume that because the wing bones of the domestic hen are light both in weight and colour and possess little marrow that these are signs of wasting (atrophy). The fact that air cavities in limb bones are not restricted to hens, but occur in other birds such as hornbills and screamers, completely refutes the suggestion that such possessions have followed so-called domestication. Vivyan has assumed that pale breast muscles and " light " wing bones are signs of degeneration and wasting, but Nature would hardly cause the wing bones to become weak (" light ") just at a time when the wing muscles were increasing in weight and capacity, *i.e.*, when the chicks were about four to eight weeks of age. Also, if these wing bones do " undergo a struggle for existence because the nourishment borne along in the blood stream is extracted by those other tissues which are more avid or greedy, by use, until at last these useless portions perish and disappear from the individual," why should they do so at such an early age when the ovary and oviduct (presumably Vivyan's " greedy tissues ") are undeveloped and without function ? Again, it is to the physiologists that one must turn for a satisfactory explanation of the " light " wing bones of the domestic hen. Whilst a chick is still a very young embryo (seven days in shell) large abdominal and other air sacs form ; a few weeks after birth these are seen to communicate with the wing bones (humerus), to which they carry air direct to the medullary cavities, the bone marrow having disappeared so to lighten the bones, and thus aid flight and respiration. Blood cell formation is compensated for by the activity of the marrow of the leg bones, and rather than being an indication of degeneration, these hollow (" light ") wing bones indicate an altered function associated with the age at which flight would normally become more active. Naked-eye air sacs and hollow bones as adjuncts to the lungs for respiratory purposes not only aid the direct and rapid interchange of gases, but also assist in the regulation of body temperature and posture.

Thirdly, if a crooked sternum (keel bone) is really " a useless appendage " (1) why does it not occur in " all prolific layers " ? (2) Why does it occur in certain non-prolific layers, and also a few cockerels ? (3) Why may it appear in some chicks early in life at six weeks of age, and much later in others at four months of age ? (4) Why can it be prevented in many instances if attention be paid to the vitamin A and D, and mineral content and balance of the diet, together with the provision of suitable perches ?

Finally, " if useless portions perish and disappear from the individual," why has the appendix of man persisted, also his beard, and why has the operation of circumcision still to be performed ? Alternatively, why has the right oviduct and ovary not regenerated in prolific layers ?

It cannot be claimed that certain anatomical features do not atrophy with very great age, but the mismanagement of birds by the poultry industry has been far too short to stimulate degenerative changes materially ; this does not, however, preclude heavy mortality due to disease from being operative. It is impossible not to agree with Vivyan's conclusion that " the high-producing hen should not

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in future be condemned as unfit for the breeding pen because she has a twist in her keel," because such a bird will obviously produce large numbers of eggs and can frequently be killed for table purposes with a well-developed breast ; two of the chief factors which concern practical poultry keepers.

DOG FOODS AND RECENT NUTRITIONAL RESEARCH.

By A. GREEN, M.C., Ph.D., M.Sc., F.I.C.
Chief Chemist to Messrs. Spillers, Limited.

STRIKING advances have been made in recent years in our knowledge of animal nutrition, but before describing how these have been adapted to dog foods manufactured by Spillers, Limited, it is advisable to outline what may be called the basic constituents of a satisfactory diet. This must contain energy-producing and warmth-giving carbohydrates and fats ; proteins of various types which are necessary for body building and the repair of wastage ; minerals to be utilised in building up and maintaining the skeleton and the teeth, and also to preserve the salt balance of the body ; and finally the various accessory factors or vitamins which are not of themselves foods, but which are essential in ensuring that the above food constituents are properly utilised, and which also enhance the natural resistance of the body to disease.

In the detailed consideration of the above constituents we will take the last-mentioned first, because vitamin research represents the outstanding feature of nutritional science during recent years. Furthermore, the vitamins are essential to life, and in their absence, even if the remainder of the diet is ideal, death with rapidly ensue.

Vitamin A is the anti-infective factor, and is marked by the increased power it gives to the body in resisting diseases, especially those which attack the respiratory system. It is found in liver oils, milk, butter, and green vegetables.

The vitamin B complex (B_1 and B_2) is closely related to the proper functioning of the nervous and digestive systems, and its importance in animal feeding cannot be exaggerated. The chief sources of this factor are yeast, the germ and bran of cereals, and the glandular organs of animals.

The absence of Vitamin C in the diet of man leads to scurvy, but in the case of dogs and certain other animals the evidence indicates that their demands are either extremely small or non-existent, or that they are able to synthesise their own supply within their bodies from their ordinary food. This vitamin is abundant in oranges, tomatoes, a variety of fruits and fresh green vegetables.

Vitamin D is the important anti-rachitic vitamin, and an adequate supply of this is necessary if sound bones and teeth are to be formed and preserved. It is found in good quality cod-liver oils, and is also formed when sunlight or

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artificial ultra-violet light acts on the unsaponifiable fraction of certain fats found in the skin and elsewhere.

Lastly, vitamin E is the factor closely connected with the reproductive functions, and is therefore known as the anti-sterility vitamin. The chief source of this is freshly-milled wheat germ, and of this Spillers have an unrivalled supply.

The wild carnivorous adult animal obtains the vitamins necessary for his well-being by selecting from his kill the glandular organs wherein they are stored. The young animal obtains a satisfactory supply from his mother's milk, but only if the mother herself receives an adequate amount of vitamins in her own diet. This is an important fact that has been frequently overlooked, and explains in human nutrition those cases of breast-fed babies who suffer from rickets and other defects due to vitamin deficiency. Since the " natural " food of wild carnivora is not available to the domesticated dog, it is essential that his diet should contain the vitamins necessary to his well-being, and these are adequately provided in Spillers' range of dog foods. The vitamins are characterised by their liability to destruction by oxidation and by heat, and after extensive researches on the subject, protective methods have been devised which ensure that the potency of the vitamins added to their dog foods is unimpaired in the cooking and baking process. The standards of vitamin potency in the finished foods are also regulated by constant laboratory tests and by biological assays or feeding tests.

Until comparatively recently vitamins were frequently referred to as " mysterious and elusive," and although the precise mechanism by which they work is still unknown, the evidence of their necessity is indisputable. Elusiveness is no longer their outstanding characteristic, for one at least is now manufactured commercially, and the synthesis of the remainder is not a remote possibility.

The importance in nutrition of minerals, mineral ash or mineral salts has long been recognised ; wild animals instinctively turn to salt-licks to remedy any deficiencies, and the chewing of ashes or coke by a domesticated animal points to a mineral deficient diet. Yet the necessity for ensuring that the food of domesticated animals and farm stock is adequately supplied with balanced mineral supplements has been emphasised only in recent years, and there are many dog foods at present on the market which are seriously deficient in this respect. Particular attention has been given to the balance between the bone- and teeth-forming elements, calcium and phosphorus, since an excess of one of these is as disastrous as a deficiency ; severe rickets can be caused by feeding calcium at a higher level than is necessary. Care has also been taken to supply those mineral salts which are necessary to the proper functioning of the digestive system, and for the maintenance of a healthy blood stream, and a small iodide supplement is also included in view of its particular value in goitre areas and its beneficial effect in all cases.

Both the animal and vegetable proteins are complex compounds built up from the relatively simple amino-acids. By the action of the digestive juices

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the proteins are broken down into the amino-acids, and from these the organism selects those necessary for its growth and maintenance, while the others are excreted. The selected amino-acids are then built into the body structure as proteins. In producing an animal food it is clearly of prime importance that the right kind of proteins, and enough of them, must be included if the animal is to thrive. Meat and other protein-rich ingredients are selected with a view to supplying a sufficient variety of the required amino-acids without loading the foods with an excess of unessential ones, which would put an undue strain on the excretory organs. From a nutritional point of view all proteins are not equally good ; in its own sphere leather is an excellent protein, but a puppy chewing a boot does not represent economical feeding from any point of view. The protein-carrying ingredients of good dog foods are selected on the basis of biological feeding value, and in this connection due regard is paid to the fact that the quality of the bitch's milk is influenced more by the quality of her protein and vitamin intake than by any other factors. As regards the energy and warmth-giving carbohydrates and fats, it is sufficient to say that only good quality flour is used in Spillers' dog foods, while the fat used is the finest edible beef dripping.

It may be thought that the above principles are difficult to maintain in commercial practice. That doubtless would be the case if the care exercised in the factories was not supported by two things : the first is a laboratory organisation which ensures that all raw materials satisfactorily conform with the rigidly defined specifications, and that the finished products are uniform and do not fall below the prescribed standards of quality ; the second factor is the periodical scientifically controlled feeding tests, the chief aim of which is to assess the vitamin potency and feeding value of the foods. These tests are very expensive, but they are the only certain means of ensuring that the essential vitamins and other nutritional elements are present in adequate amounts.

Finally, the question of palatability is not forgotten. The theoretically ideal food is useless if the dog will not eat it. No spices or appetisers are used in Spillers' dog foods, and their palatability is due solely to the wholesome, balanced ingredients, skilfully blended, aerated and baked, so as to ensure the maximum digestibility and assimilation.

Reviews

Regional Anæsthesia of the Head in the Domestic Carnivora. By A. Sourdin. Thesis for degree of " Docteur Vétérinaire," Alfort, 1933.

This work deals with regional anæsthesia of both jaws, the orbit, and external ear in the dog and cat. It runs to 60 pages, and the introduction and bibliography refer, in addition, to the horse.

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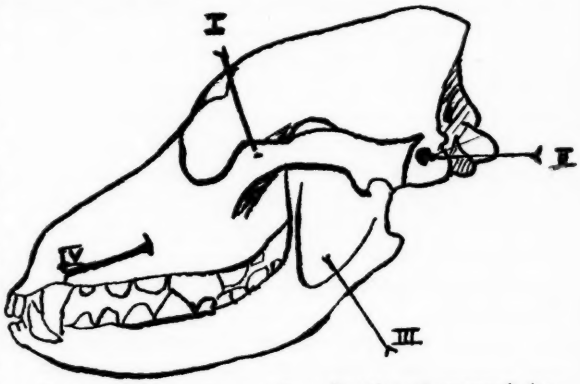
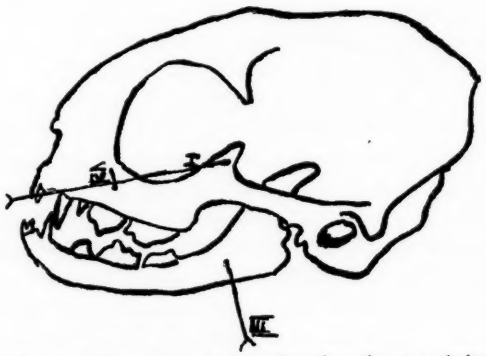
Dental Anæsthesia.—Dental nerve block for the upper jaw in the dog is effected by injecting local anæsthetic fluid upwards through the infra-orbital foramen, and that for the lower jaw by depositing by injection local anæsthetic fluid at the mandibular foramen, *i.e.*, at the proximal extremity of the mandibular canal. By this means all teeth except perhaps the last two molars of the upper jaw can be anæsthetised. (The method is described fully in a paper published in the *Veterinary Record* in 1932.) In the cat the infra-orbital foramen is situated very close up to the orbit, and the canal is extremely short. The principle of the method is the same for application to the dog.

Orbital Anæsthesia.—The ophthalmic, frontal, lachrymal and naso-ciliary nerves are mainly concerned with the sensory nerve supply of the orbit. They all lie close together in the neighbourhood of the orbital fissure of the cranium, whence they diverge distally. The author blocks them by local injection, the needle being inserted almost vertically immediately behind the supra-orbital process of the frontal bone, and directed slightly medially and caudally. The correct depth to penetrate is given as twice the distance between the internal and external angles of the eye. The injection should be made rather quickly in order to obtain a compact deposition of anæsthetic fluid around the nerves named above. In the cat the author approaches the analogous site by inserting the needle through the infra-orbital foramen (as in maxillary nerve block) but further on into the lower part of the orbit until bone is reached in the neighbourhood of the sensory nerves as in the dog. Here again the correct distance to penetrate is given as twice the distance between the internal and external angles of the eye. By this method of regional anæsthesia the contents of the orbit can be anæsthetised, so that the operation of enucleation of the eyeball can be performed without pain to the patient.



SKULL OF DOG. Arrows show direction of approach for anæsthetising: I—the orbit; II—the ear; III—the lower jaw; IV—the upper jaw.



SKULL OF CAT. Arrows show direction of approach for anæsthetising: I—the orbit, by same route as for IV—the upper jaw; III—the lower jaw.

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Aural Anæsthesia.—The dog is alone dealt with by the author in this respect. The sensory nerves supplying the external ear are the atlantoid branch of the second cervical, the occipital branch of the fifth cervical, and the anterior auricular nerve—a branch of the fifth cerebral nerve. These small nerves ramify close together behind and below the base of the external ear, and can be approached for the purpose of nerve block by a needle inserted between the prominences formed behind by the wing of the atlas, and in front by the osseous bulla of the temporal bone; these can be determined by palpation. The needle is inserted at first horizontally inwards, and then forwards, so that its point comes against the osseous bulla, where the injection is made. A fairly large dose is recommended. By this method the entire external ear can be anæsthetised.

J. EDWARDS.

Elementary Histological Technique for Plant and Animal Tissues. By J. T. HOLDER. London: J. & A. Churchill. Price 7*s.* 6*d.*

A KNOWLEDGE of the methods of preparing tissues for microscopical examination has in the past been possessed by few veterinary practitioners (whose microscopes have, no doubt, helped to make the surgery impressive). The extended course of training now enables the student to learn something of laboratory methods, and to understand the rationale of microscopical technique will no longer be the prerogative of the research worker. The latter will still require Bolles Lee's well-known *Vade mecum*, but here at one-fourth the price of that work is a hand-book detailing in concise form the well-established methods for fixing, sectioning, staining and mounting such tissues and objects as are likely to concern the student and practitioner. The book has a good index, and is strongly bound for hard wear. A darker colour for the binding would not soil so easily, and the title on the back edge is upside down; two rather annoying points that could easily be rectified.

News

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

(April 27th.)

BEFORE LORDS JUSTICES SCRUTTON, GREER AND SLESSER. BASTIN *v.* GODSTONE RURAL DISTRICT COUNCIL. YOUNG *v.* SAME (CONSOLIDATED).

Human sewage in stream—Pollution alleged as result of discharge of effluent—Onus of proof on plaintiffs not satisfied—Held that cattle illness not due to human sewage—Appeal allowed and judgment in King's Bench Division reversed.

AN appeal was brought by the Godston R.D.C. against the judgment of Mr. Justice Horridge in the King's Bench Division in favour of Mr. John Percy Bastin and Mr. Arthur Young, two farmers in the Lingfield area, who claimed damages in respect of the alleged pollution by the Council of a stream running through their farms by sewage effluent from the Council's sewage disposal works.

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Mr. Bastin and Mr. Young alleged that for some time before November, 1929, when they removed their herds from the meadows bordering the stream, there was a distinct falling off in the condition of their cattle, which involved them in serious losses. Sewage poisoning was eventually diagnosed.

The Godstone Council denied that the cows suffered from sewage poisoning, or that the effluent from the works was such as to cause injury to the cattle.

Mr. Justice Horridge awarded £2,008 damages to Mr. Bastin, and £1,939 to Mr. Young, and granted an injunction to restrain the Council from discharging effluent into the stream so as to cause danger to the plaintiffs' cattle. From this decision the Council appealed.

Mr. Norman Birkett, K.C., and Mr. R. Fortune (instructed by Kinch and Richardson, agents for Wheeler and Brill, Oxted) appeared for the appellant Council; and Mr. J. Flowers, K.C., and Mr. R. Jennings (instructed by Mr. Guy Wallington, agent for Buckwell and Wallington, Brighton) for the respondents.

Mr. Birkett contended that the judgment of Mr. Justice Horridge was wrong, and that he was under a misapprehension about the Council's sewage works, largely due to a witness for the plaintiffs, who said that, though the works were all right, they were not operated long enough, and if they were worked for longer hours there would be a purer effluent which would give no trouble. The plaintiffs' case was based mainly on the evidence of Mr. Dier, a veterinary surgeon, who merely said he attributed the harm to the plaintiffs' cattle to sewage poisoning. This presumption was, counsel argued, vague and unscientific, and was entirely displaced by the large body of the highest scientific evidence in the land, called for the Council, which proved that the effluent was quite innocuous, that there was, in effect, no pollution of the stream, and in any case the effluent was from human sewage, which was quite harmless to cattle, even if crude. The suggestion by the Council was that if there was anything the matter with the plaintiffs' cattle it might have been due to natural disease or drinking water polluted by cattle droppings, and that in any case wastage in the plaintiffs' herds never reached 25 per cent., which was the normal wastage loss. He contended that the plaintiffs did not discharge the onus on them of proving that the damage of which they complained was due to the effluent, and that the injunction ought certainly not to be allowed to go because at the date of the trial of the action there was no ground on which it could be granted.

After hearing arguments lasting for several days the Court reserved judgment.

JUDGMENT—JUNE 26th.

Lord Justice Scrutton observed that on Mr. Bastin's claim of £4,677 Mr. Justice Horridge awarded £2,008, and Mr. Young's claim of £4,577 was reduced to £1,939. Both claims, in his Lordship's opinion, were very exaggerated. After a careful and prolonged consideration of the evidence, said Lord Justice Scrutton, and an analysis of the history of the stream in question, he had come to the conclusion that the respondents had failed to satisfy him that any lack of

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condition in their cattle was due to effluent from the appellant's sewage farm. He inclined to the view that cattle could not be damaged by drinking human sewage, but it was enough for him to say, in the present case, that the plaintiffs had not proved that it could. It followed that the plaintiffs' claim failed and the appeal succeeded.

Lord Justice Scrutton, before proceeding with a detailed analysis of the evidence, referred to the great body of expert and scientific evidence called by the rural council to show that there were no elements in human sewage which could produce the diseases to which the cattle were subject. That was supported, he said, by the evidence that the cattle themselves might infect the stream with Johne's disease. There was no trace in veterinary literature of cattle disease being due to human sewage effluents being discharged into streams, and experiments conducted at the Research Department of the Royal Veterinary College on three healthy cows—which drank nothing but effluent from the appellants' plant, neat or diluted—showed that in their case no injury was caused.

Among other findings Lord Justice Scrutton said there was no satisfactory evidence that the cattle droppings, which might include the bacilli of Johne's disease and other diseases, could not, and did not in that case, injure the cattle. Johne's disease was common in the area concerned, which, owing to winter floods, was favourable to its development. His Lordship added that he came to the conclusion that the sewage plant was well designed and efficient, and he could see no reason for granting against the council an injunction to restrain them from discharging effluent into the stream. He thought the appeal, therefore, should be allowed, and judgment entered for the council, with costs in that court and below.

Lord Justice Greer, who disagreed, said the evidence of the two plaintiffs, accepted by Mr. Justice Horridge, was supported by the evidence of practical veterinary surgeons. He thought it extremely unlikely that, had the plaintiffs' cows been suffering from Johne's disease—which, except when treated in the earliest stages, was almost always fatal—they would not have recovered. He did not think it was safe to draw any conclusion from the experiment mentioned, as the cows concerned were not fed under the same conditions, and the effluent which they drank in 1931 was no doubt better than that which the plaintiffs' cows drank from 1926 to 1929. He was of the opinion that the trial judge was right in awarding damages.

Lord Justice Slesser gave a judgment concurring with that of Lord Justice Scrutton, and the appeal was accordingly allowed, with costs, and the judgment as to damages and the injunction in the court below was set aside, with costs.

Mr. Norman Birkett, K.C., and Mr. Robert Fortune (instructed by Messrs. Sharpe, Pritchard & Co., agents for Messrs. Wheeler & Brill, of Oxted) appeared for the Rural Council; Mr. John Flowers, K.C., and Mr. Raymond Jennings (instructed by Mr. C. C. Wallington, agent for Messrs. J. C. Brockwell & Co., of Brighton) represented the respondents.

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Correspondence

LIGHTNING STROKE.

To the Editor of THE VETERINARY JOURNAL.

SIR,—*Re* the note on "Lightning Stroke," published in your June number. I shall be very grateful if you will let me make two corrections: A number of photographs in my possession were kindly given to me by the Yorkshire Insurance Company, but for the one showing a bunch of sheep lying near a fence, I am indebted to Dr. Mahommed, an authority on the subject; and I am sorry if I did not mention this when the photographs were sent to you. The wording under the photograph is, however, not mine. As far as is known, this lot of sheep was killed, not by a flash which ran along the fence, but by lightning which found the earth nearly a mile away.

Penzance.
June 26th, 1933.

Yours faithfully,
S. J. MOTTON.

THE VETERINARY PROFESSION AND ANIMAL DISPENSARIES.

To the Editor of THE VETERINARY JOURNAL.

SIR,—I have been asked, on various occasions, by veterinary practitioners I have called upon, my opinion as to the present position of the above. It seems that something is required to wake up the veterinary profession: let them get out and see what is actually taking place as regards the unqualified man and the various Societies such as the P.D.S.A. Both are grasping what the M.R.C.V.S. people ought to be holding. So-called "free clinics" are opening out all over the place—London and the provinces. Men that are cast off or leaving the P.D.S.A. find openings for themselves, and quite a few I know, by my calls, are doing very well. The public are drawn to their premises—usually a shop in the main road—by large and attractive letters: "Canine Surgery," "Dogs Boarded," "Clipped," "Groomed," and at reasonable prices. In some no fee is charged but a box is put forward.

The M.R.C.V.S. is only allowed a small plate, and in many instances it is hardly noticeable. My contention is that there is ample scope for the profession if the R.C.V.S. Council would allow more scope. The College should enter into the spirit of things—take some places—put qualified men into them; run them on well-directed lines; let the people know that the qualified man can do the job in a quarter of the time, and at less expense than these so-called "Free" Canine Clinics. By these means they would wedge out many of these, and secure good practice for many of the veterinary profession. Take Ilford, Chelsea, Hammersmith, Fulham, and many other places in London alone, these districts are all covered by the professional man. More scope is required by the veterinary profession to draw the public's attention to their practice.

When, at the National Veterinary Congresses held at Norwich and Folkestone, in conversation with Professor Hobday, I mentioned these facts, he asked me to voice the matter as a layman. Since then on two or three occasions I have been urged by other veterinary surgeons to put these facts forward. I am doing it through you if you think it worth while to place it further. *"Free Clinics" are misnomers. "Free Destroyers" would be better for some places.*

Please do not think I am casting slurs upon the great majority of "free clinics." These societies opened with good intentions, but they have gone much further than it was ever understood they would go. One wonders whether the kind-hearted public who subscribe to these "philanthropic" societies realise this.

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In the course of my business I call upon all that come within my view, and I gather a lot from them ; and I say again that the veterinary profession ought to be taking this work in hand. Heaps of money is being left to these various societies, but if the Council of the Royal College of Veterinary Surgeons became pioneers and encouraged dispensaries in the very poorer districts their philanthropy would be soon well known, and monies would be left to the College as well as to outsiders ; by which means the R.C.V.S. would be helpful to the profession.

I am sure that the animal must often be the sufferer from wrong diagnosis, and I consider that the animal of the poor man has as much moral right, when sick, to a correct diagnosis of, and proper treatment for, its ailment, as the animal of the rich. My own personal experience enables me, too, to say that the poor man is anxious to obtain this for his animal pal whenever he can ; but if the profession will not meet the demands put upon it by the public it has only itself to blame if the quack slips in and seizes the opportunity to divert money, which should go into the veterinary surgeon's pockets, into his own.

Yours faithfully,
JAS. RAYE.

PROFESSOR SIMONDS AND THE BUNGAY HORSE SKULLS.

To the Editor of THE VETERINARY JOURNAL.

SIR,—The house occupied for many years by Professor Simonds and his grandfather in Bungay was near the Norfolk border, and was part of the estate belonging to Lady Haggard's family. Sir Rider sold it about the year 1917, and in a " Farmer's Year," page 171, mentions a large tablet which was sunk in the then front wall of the house with the following inscription, which was probably placed there by one of the Simonds.

" To show how extraordinarily the price of the different kinds of grain may vary in the course of a century, I will here copy out the contents of a tablet which is let into the front of a house belonging to this estate in Bungay : Prices of grain per coomb, April 3rd, 1800 : Wheat, £3 2*s.* ; barley, £1 15*s.* ; malt, £1 18*s.* ; pease, £2 10*s.* beans, £1 10*s.* ; oats, £1 4*s.* ; hay, per cwt., 7*s.* 6*d.* ; straw, 3*s.* 6*d.*"

Sir Rider goes on to compare these prices with those of the year 1895, and adds : " but these figures do not show all the difference, since it is to be presumed that in the year 1800 gold was scarcer and the purchasing power of money greater than is the case to-day."

I am told that Professor Simonds practised in this house as a veterinary surgeon some seven years before he left Bungay, and that previously another member of the family lived there and carried on the same profession. I conclude this would be his grandfather, who brought him up. The premises are now occupied by a butcher's shop, but the tablet remains on an old wall at the back of the present house. At the time of the Simonds tenancy they rented, besides the house, stables with five loose boxes, a double forge, and grass land.

In regard to the curious discovery of the horse skulls, already mentioned and illustrated by the photographs and description in THE VETERINARY JOURNAL of May last, I have made every inquiry amongst the oldest inhabitants in the town and have found definitely that Professor Simonds did not live in the house in which the skulls were found. The reason to explain why these were put there is certainly a mystery. That there must have been some reason for it seems pretty definite from the trouble taken, not only to collect so many together, but to clean them so effectively and to place them so symmetrically—each upper set of incisors being supported on a wooden block—all in such regular order.

Yours faithfully,
ETHEL MANN.

Earsham Street, Bungay.

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Personal

RETIREMENT OF MR. LLEWELYN BEVAN.

MR. L. E. W. BEVAN, M.R.C.V.S., Director of Veterinary Research, retired from the service of Southern Rhodesia on June 4th, a service in which he had been engaged since 1905. In addition to his duties as District Veterinary Officer, Mr. Bevan carried out many original investigations into animal diseases. In 1909, Mr. Bevan was gazetted Government Veterinary Bacteriologist, taking charge of the Veterinary Research Laboratory and Station, which, as Director, he can truthfully be stated to have founded and established on a firm footing. During his years of service Mr. Bevan made many scientific discoveries which contributed to the development of the pastoral industries of the country. In 1909 he studied and identified the animal trypanosomes of Southern Rhodesia, and described the human trypanosome which was afterwards named *T. rhodesiense*. He also introduced the antimony treatment of tsetse fly disease, which has saved the lives of many thousands of cattle. Having studied the diseases known as red-water and gall-sickness of cattle, Mr. Bevan, in 1908, evolved a method of protection which has contributed very materially to the improvement of stock, and in 1913 he introduced a very successful method of protective inoculation against horse sickness, which has greatly reduced the mortality from that disease. Very few men in the profession have done so much practical good for animal health, and it seems an anomaly that the services of such a valuable servant should not be utilized for a few years longer, even if only in an advisory capacity.

MR. GEOFFREY B. BROOK, B.Sc., M.R.C.V.S., late House Surgeon of the Royal Veterinary College, London, and a graduate from the Royal (Dick) Veterinary College, Edinburgh, was awarded the degree of Doctor of Science (in the Department of Veterinary Science) at the recent graduation ceremonial of the University of Edinburgh. The work constituting the thesis, "Experimental and Clinical Studies of the Spine of the Dog," was a research carried out during the tenure of the Centenary Fellowship of the Royal Dick College at Edinburgh and Stockholm. Dr. Brook is presently Veterinary Officer to the County Council of Derbyshire Agricultural Institute.

AUG 14

Publishers' Notices

All communications should be addressed to 7 & 8, Henrietta Street, Covent Garden, London, W.C. 2. Telephone: Temple Bar 4646. Telegrams: "Baillière Phone, London."

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